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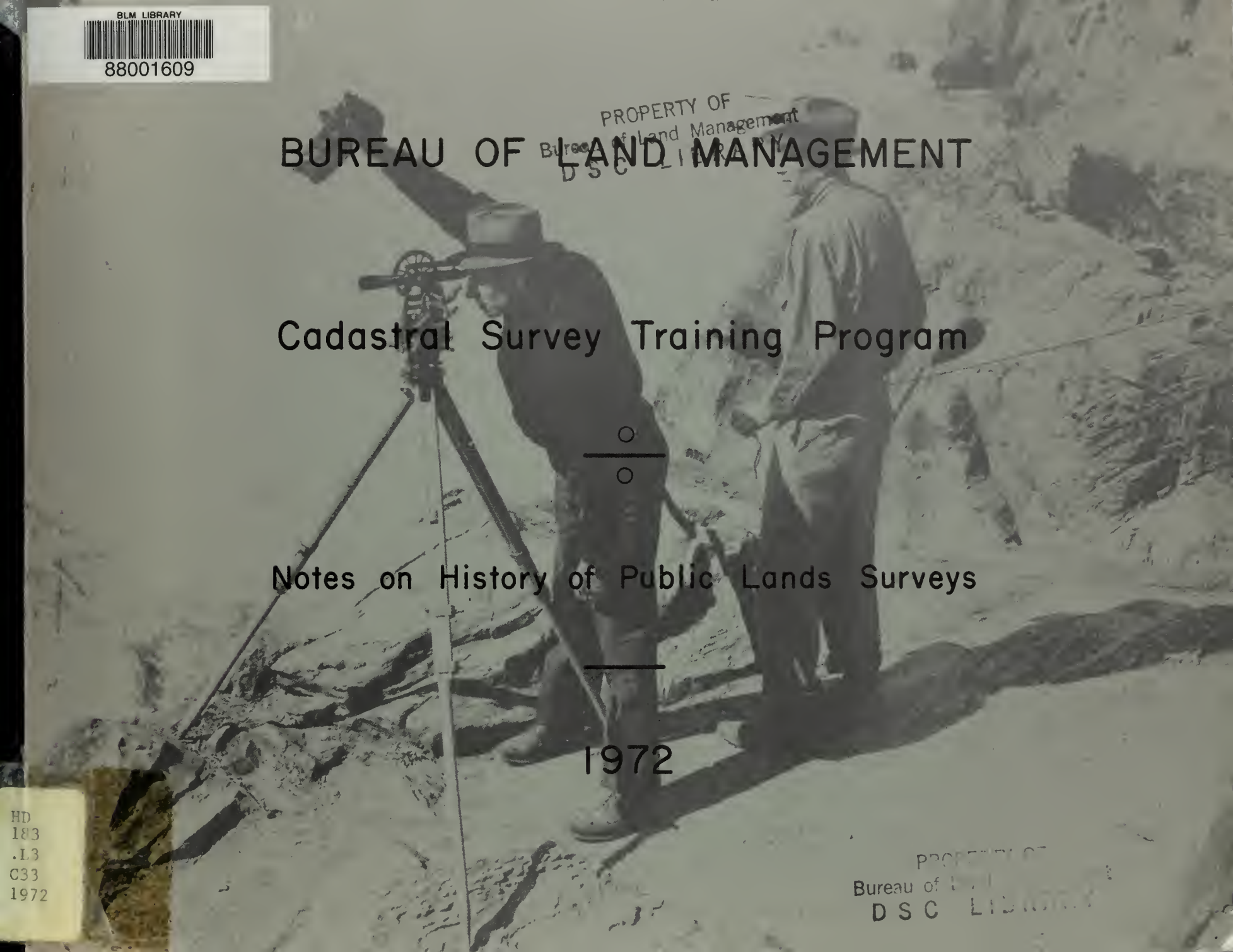

Cadastral Survey Training Program

Notes on History of Public Lands Surveys

1972

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CHAPTER	PAGE	LOCATION	ERRATA (change)	COPY SHOULD READ
18	2	Line 1 - Right Hand Caption	Richard E. (Elmer) Bardy	Richard E. (Elmer) Bandy
18	9	Line 4 - Lower Caption	Heister's Survey Party	Hiester's Survey Party
18	20	Line 2 - Lower Caption	Moving camp. T.5N., R.TE.	Moving camp. T.5N., R.7E.,
20	1	Line 2 - Right Hand Caption	Parallel North, T.37N., R.ZE., Arizona	Parallel North, T.37N., R.2E., Arizona
20	9	Line 6 - Top Caption	A. N. Kimmell, Thomas E. Heister	A. N. Kimmell, Thomas E. Hiester
20	18	Line 1 - Right Hand Caption	Emil Voight (-------)	Emil Voigt (pipe and all)

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FOREWORD

Cadastral surveys are performed to create, mark, and define or to retrace the boundaries between abutting land owners and, more particularly, between land of the Federal Government and private owners or local governments. As referred to here, cadastral surveys were performed only by the General Land Office during its existence and by the Bureau of Land Management. The Bureau of Land Management is the only agency which is currently authorized to determine boundaries of the public lands of the United States.

Proper understanding of the basis for performance of cadastral surveys includes an understanding of the history of the public land surveys. An understanding of that history requires some consideration of the people who performed these surveys and of the people whose land was affected by them.

These notes were prepared as an aid in training cadastral surveyors in the application of surveying principles. The learner is expected to gain from the factual material on survey laws and their formation as well as from a study of the people who performed the surveys. Many of the men who had an important role in the history of cadastral surveying are still living but only those who have retired are included in the present document.

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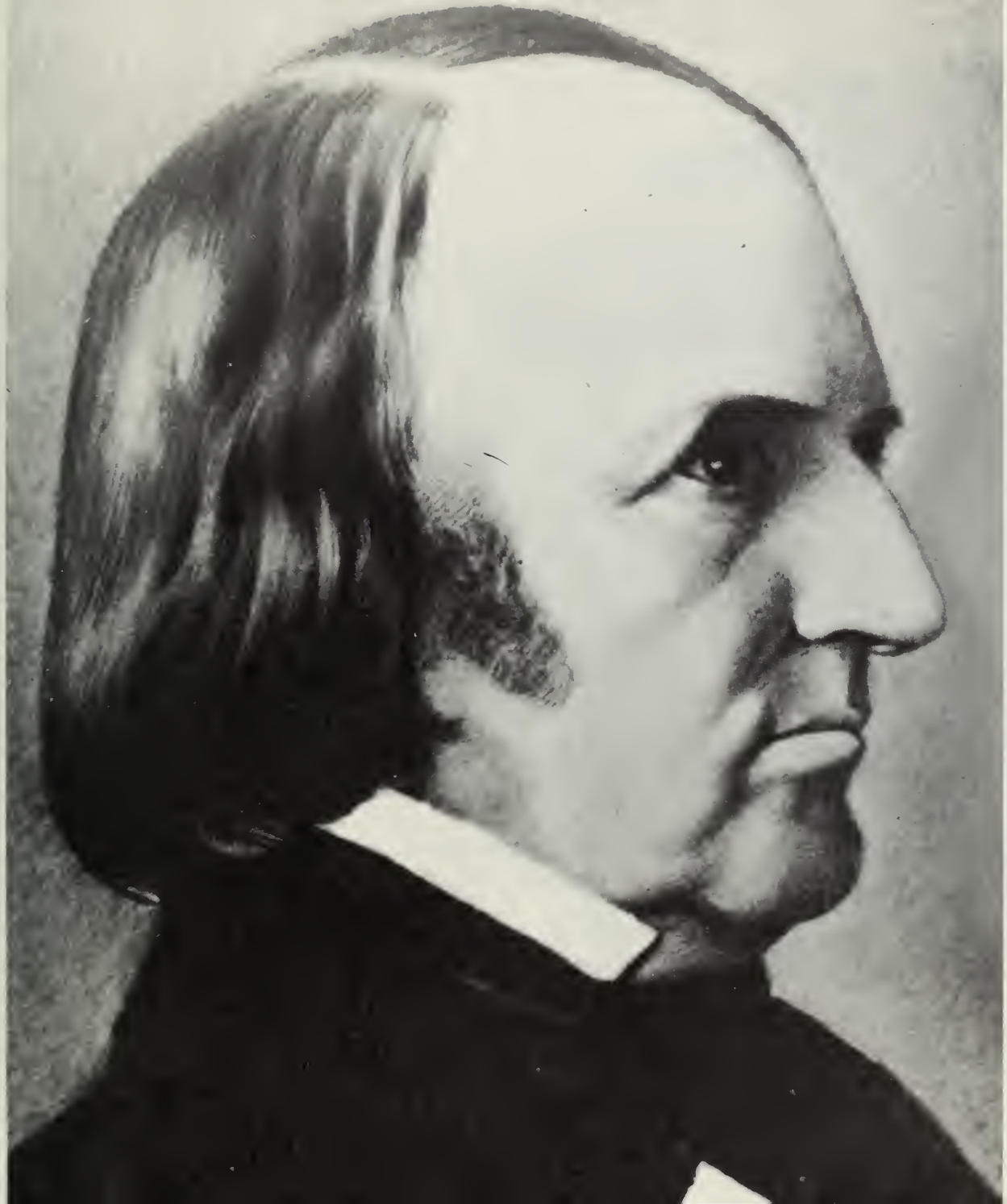
INTRODUCTION

In March of 1836, Congress received a report from Ethan A. Brown, Commissioner of the General Land Office. It included the following:

> "...it is respectfully suggested that the surveys are at the base of the land system..."

The surveys to which he referred are cadastral surveys. These are the surveys which create, mark, define, retrace, or reestablish the boundaries and subdivisions of the public lands of the United States.



Ethan Allen Brown, Commissioner of the General Land Office, 1835-36

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ANCIENT SURVEYS

"When he prepared the heavens, I was there: when he set a compass upon the face of the depth:"

Proverbs 8:27

When an individual first felt the desire to possess land the need for the work of a cadastral surveyor became inevitable. This occurrence is lost in antiquity, as is the moment when man first found he could strike flint and make fire his servant, or the first time man perceived the principle of the wheel.

Before recorded history, cave men claimed their homes and hunting grounds by right of occupancy and a large club. Disputes over boundaries have always, along with God, politics, and taxes, awakened men's hidden passions. To the surveyor must go the credit for the lessening of disagreements over property lines.

Surveying itself has no "point of beginning". We know that a very ancient clay tablet exists. It is Assyrian in origin, and was found at Nuzi, near Kirkuk. It dates from the dynasty of Sargon of Akkad, well over 5,000 years ago. Scratched into its surface is a map, showing a surveyed part of what is now called Iraq (northern Mesopotamia). (34)

The Egyptians, under the Pharaohs, devised extremely precise methods of measurement. The Great Pyramid of Gizeh (Khufu) is the most famous example. Its base is oriented in the cardinal directions. The four sides (9,068.8 inches) have an average error of just six-tenths of an inch in length and twelve seconds in angle from a perfect square. It was constructed about 4700 B.C. (90) No record exists today of the methods the Egyptians used, or of their equipment. We do know that they were concerned with the survey of land lines for purposes of taxation. The land in the Nile Valley had to be surveyed over and over because of the yearly flooding of the Nile.

Three or four thousand years ago the Babylonians took their surveying seriously. There are in existence today a few of the boundary stones set during that period. One of them has much carving upon it, most of which has been translated into English. It refers to the size of the land, five gur of corn-land, measured by the great cubit. It gives the district, the province, and the location. The name of the surveyor is also given, along with the fact that it was an official survey and established the land as the property of Gula-Eresh. The translation also gives, at great length, the numerous curses to be called down upon the head of anyone so foolish as to move the stone. (94)

A surveying instrument was found in the ruins of Pompeii. It was a groma, of the type used by the Romans in dividing land to be distributed to veterans. The groma had four arms, set at 90 degrees to one another, with which the corners of rectangular plots were established. The Roman system of land subdivision was called agro centuriato, land divided into hundreds. (34) Julius Caesar ruled Rome when agro centuriato was introduced. He died 44 years before the birth of Christ, but the subdivision pattern created by different land uses under this survey system is still visible from the air. (36)

Long before the reign of Caesar, the first five books of the Old Testament were written.

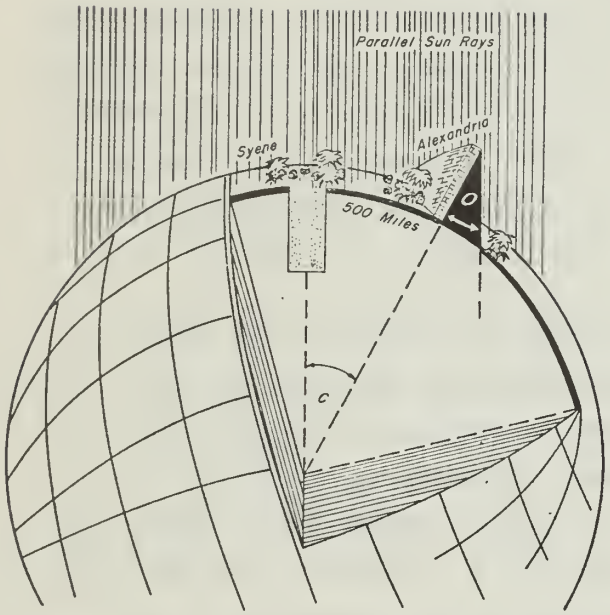
The Graf-Wellhausen theory says that these five books, the Pentateuch, at one time consisted of four major documents which were combined into a single literary unit about 400 B.C. (33) Many times within the Pentateuch, and in the rest of the Bible, reference is made to the survey of land.

Biblical units of measure were simple and none too exact. For the most part they consisted of approximates arrived at by the use of ones body. The cubit was the length of a man's arm from his elbow to his extended finger tip, about 18 inches. A span was the reach of a man's outstretched hand, from finger tip to finger tip, or about 9 inches. A palm was all four fingers, or about 3 inches. A finger was about three-fourths of an inch. Two spans equalled 1 cubit.

In Ezekiel 40:5 and 43:13 a long cubit is mentioned. It is compared to a cubit and a hand breadth. The Acts 27:28 mentions fathoms. This was the length of a man's outstretched arms, or about 6 feet.

The reed was an instrument used in measuring, and according to Ezekiel 40:5, it was 6 cubits long. The measurement of land was related in 1 Samuel 14:14, to the area a team of oxen could plow in 1 day. In some places area was indicated as the part of a field which could be seeded to barley in 1 day. In Mesopotamia the meaning of "acres" as used in Isaiah 5:10, was about two-fifths of our present acre. (33)

About 500 years before the birth of Christ, Pythagoras, the Greek, suggested that the earth might be spherical rather than flat. Eratosthenes of Cyrene, who lived from 276 B.C. until 196 B.C., thought he was right. Eratosthenes was an intellectual type who became the head of the Alexandrian Library. His intellectual curiosity paid off when he learned that, at the peak of the summer solstice, the sun illuminated a deep vertical well in Syene. At noon, on the longest day of the year, he measured the angle of the shadow cast by a vertical wall in Alexandria. It was equal to one-fiftieth of a circle. He thought that Alexandria and Syene were on a



Eratosthenes' application of basic geometry in determining the circumference of the earth.

direct north-south line, and he knew the accepted distance between the two cities. His theory, based upon his observations, was that the distance between the cities was equal to one-fiftieth of the circumference of the earth.

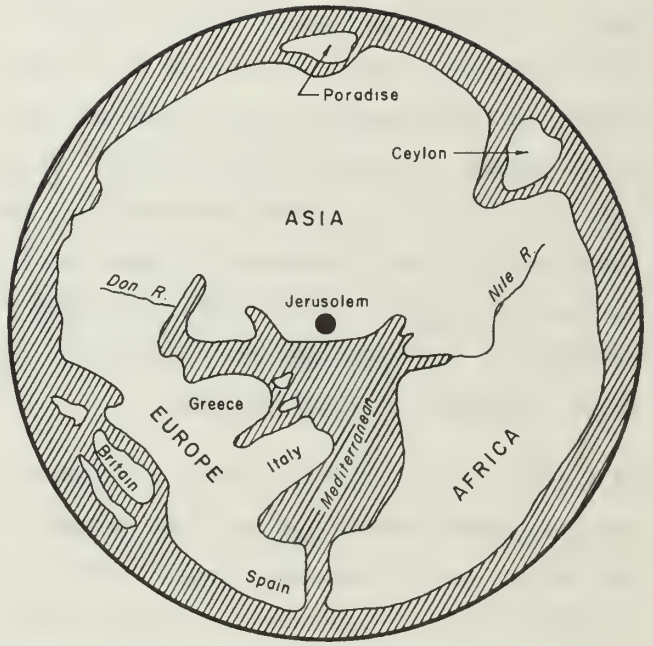
He came very close. He used units of length called stadia and, because of compensating errors, came up with a distance of 24,662 miles. Since the earth is not a perfect sphere, and Syene and Alexandria are not exactly the distance apart that he used, and are not on a perfect north-south line, he was a little off. The real figure is 24,899 miles. (34)

This was the first attempt to find the size of the earth by measuring the arc of a meridian. It was quite a feat in the advancement of surveying. The only thing wrong about it was that people couldn't believe the earth was that big. Geographers, until the close of the 15th century, did not accept the findings of Eratosthenes. They used the calculations of

Poseidonius (130 B.C. - 51 B.C.) and came up with a circumference of 18,000 miles. (34)

This useful figure helped the Church to convince people, during the middle ages, that Jerusalem was the center of the world. The maps of that period are narrow in concept, and are often called T in O maps due to their stylized depiction of what people wanted the world to look like. (29)

When William the Conquerer invaded England in 1066, he changed the manorial land tenure system to the feudalism of France. (95) Under this system, the lords of the manors paid a fixed sum to the king. About 20 years later, William ordered a survey of the lands of England. It was done, and is called the Domesday Book. It is a description of the land, with the names of the owners, and the nature, extent and value of their holdings. (12) It was made so that there might be a more accurate assessment of the sum to be paid to the king.



Facsimile of a T in O map showing the usual depiction of the world in the middle ages. Jerusalem was shown at the center of the world, and the Asian location of Paradise gave us the phrase, "to orient a map."

The lords really did not fare too badly. They often met their payments by lending their serfs to the king as soldiers. (12) This was considered a good way to raise an army during the wars, undertaken by European Christians between the 11th and 14th centuries, to free Jerusalem.

While in Europe the Crusaders were trying to recover the Holy Land, the people led by the Incas, in South America, were producing beautiful things of silver and gold. (25) Using methods unknown to us, they surveyed land and constructed cities, pyramids, bridges, and an extensive system of roads. They developed terraces on the hillsides for cultivation, and built tremendous irrigation works.

They had no iron or steel tools, yet there are Inca canals which can still be traced for miles. At Cajamarca, a canal which extended for over a mile was cut in solid rock. At one place they cut the canal in a zig zag pattern. Apparently this was one of their methods of controlling the flow of water. At Huandoval, two canals meet and cross, one above the other. There was once a third canal below the other two. (25)

The ancient Inca fortress city of Macchu Pichu, set near the top of a mountain, was built of huge blocks of stone. No cement was used in its construction, but the stones were so carefully fitted that some of the walls and stairs are still intact and plainly visible in aerial photographs. (19)

The real beginning of European exploration took place in the 15th century during the time of Prince Henry, the Navigator (1394-1460). Through Prince Henry's farsighted effort, Portugal, at least 50 years before the rest of Europe, started exploring the seas.

One of the major factors in Portugal's expansion of travel to the unknown was the discovery of the Azores, and the growth of the Portugese settlement there. A man named Christopher Columbus lived there with his wife's family where his father-in-law taught him to use navigational and surveying instruments. Undoubtedly, it was in the Azores that Columbus first

dreamed of sailing farther than man had sailed before. (34)

Perhaps it is just as well that geographers had accepted the theory that the earth was 18,000 miles around. Maybe Columbus would have delayed his voyage if he had known how big it really is!

COLONIAL AMERICA

"Then said I, Whither goest thou? And he said unto me, To measure Jerusalem, to see what is the breadth thereof, and what is the length thereof."

Zechariah 2:2

Shortly after Columbus' famous voyage, an Italian navigator in the service of England, John Cabot, discovered the coast of North America. Soon after that Ponce de Leon explored Florida, and claimed it for Spain. In 1519 Hernando Cortez began to explore and conquer Mexico, also on behalf of Spain. One year later, Magellan sailed through the Strait that bears his name and confirmed the theory that the world was round.

During the next 20 years or so, Lower California and the Gulf of California were found and explored. Coronado explored, and claimed for Spain, a large area north of the Rio Grande. The Grand Canyon was discovered by Don Garcia Lopez de Gardenas, and Hernando de Soto started exploring the Mississippi River.

On the evening of November 16, 1532, the Inca Atahuallpa was ambushed and taken prisoner by Francisco Pizarro. The Inca army was overwhelmed and scattered. In 3 or 4 hours, the strength of the most powerful empire in the New World was broken. The riches of Peru went to Spain, and a civilization, recognized as

remarkable even by those who destroyed it, was ended. (25)

At about this same time, a 21-year-old publisher named Gemma Frisius issued the first edition of "Cosmographia", by Peter Apian. The second edition, in 1533, went into detail about a surveying method he claimed was completely new. It was a way of surveying a large area without direct measurement. The idea was that if all angles and the length of one side are known, the lengths of the other two sides of a triangle may be figured on paper.

The ancient Greeks probably originated the idea, but Frisius was the first to publish it. It was over 80 years more before someone put the formula to actual use. In 1615, a Dutch mathematician named Willebrord Snell, who was a professor at Leyden University, measured a base line and used triangulation to determine the arc of a meridian. (34)

The land surveyors in the early 17th century did not often have the training and background in mathematics that Snell did. It was to compensate for the fact that the geometrical devices used in triangulation were beyond their grasp that the plane table became popular. Surveyors of that time also possessed the compass, chain, astrolabe, the telescope, and a forerunner of the theodolite. (34)

Both William Shakespeare and Galileo were born in 1564. One year later the first Spanish colony in America was founded at St. Augustine, Florida. About 20 years after that, Sir Walter Raleigh asked the famous mathematician and surveyor, Thomas Harriot, to accompany Sir Richard Grenville to America. He did so, and surveyed parts of what was to become the State of Virginia. (102)

Jamestown, the first permanent English colony in America, was founded by the Virginia Company in 1607. Shortly after that, Galileo perfected the telescope. About the time Snell determined a meridional arc by triangulation, the headright system of land tenure was adopted in Virginia. Under this system, each person who paid his own or someone else's transportation

to America from England was granted 50 acres of land. (1)

In 1620 Elder William Brewster brought several books to America with him on the Mayflower. Among them was a work on surveying. There is no record of what it was, but Aaron Rathbone's, "The Surveyor", which had been published in London 4 years earlier, (102) was well thought of at the time.

New England settlers were granted tracts of 10 to 100 acres by the general courts. This sounds pretty good, until you find out that the English officials who made these grants voted themselves tracts of 1,000 to 9,000 acres! (1) The surveying of all these new tracts of land was vitally important to the colonists.

Nathaniel Foote was one of the first American colonial surveyors. He surveyed in Massachusetts, but left there in 1634, going by way of the Connecticut River, to settle Wethersfield, Connecticut. Foote laid out the Common and home lots. He established the Hartford-Wethersfield boundary line a couple of years later. (102)

In the summer of 1730 Timothy Dwight completed the survey of a plot of land containing 200 acres, "adjoining to the South Side of Chickabey River on both sides of Chickabey brook by order of the Great and General Court or Assembly of the Province of the Massachusetts Bay Begun and Held at Salem August 28, 1729....". His father, Nathaniel Dwight, was also a surveyor. One of Timothy's descendents became a president of Yale. (112)

Fifteen years before that, John Chandler surveyed over 10,000 acres of land, "Adjoining to the said Township of Hadley on the North, on Connecticott [sic] River Westerly and on Springfield Southerly. The Lines are run by the needle of my instrument, allowing no variation - Protracted by a scale of 200 perch to an Inch....". (112)

During the colonial period, Augustine Herrman was also engaged in surveying and map making in Maryland and Virginia, Andries Hudde sur-

veyed and mapped New Amsterdam, and Solomon Saffrey and Nathaniel Woodward ran the boundary between Rhode Island and Massachusetts.

Even though the instruments they used were rough and crude by present standards, a creditable job of surveying was done by these men; and later by men like Daniel Leeds, Surveyor-General of West Jersey Province (New Jersey), and Quaker Surveyor General Edward Penington, of Pennsylvania. (102)

In colonial times, private schoolmasters taught evening classes so that those who could not attend school during the day could receive an education. Surveying and navigation were said to be the most popular mathematical subjects featured. This may have been due to the fact that the "bounds" of a vast new land were in the process of being marked. Since the land grants were often unclear, the subject of surveys and land lines was of great importance in the everyday life of the colonists. One of the people most admired in a colonial community was the land surveyor, or "boundsgoer". Boys often trailed along as the surveyors ran their lines. Many of those boys learned the fundamentals of this praiseworthy skill as they walked beside the boundsgoer. (5)

John Jenkins, Sr. (1728-1785) and his son John, Jr. (1751-1827) worked as a survey team. Between fights with Indians they surveyed the area in northeastern Pennsylvania known as the Wyoming Valley. (103) This was a rich anthracite region claimed by both Pennsylvania and Connecticut. The Susquehanna Company was formed in 1753, in Connecticut, to develop and settle the valley. This settlement resulted in the Pennamite Wars. The military leader of the Connecticut settlers was Zebulon Butler.

In 1778 during the Revolution, Loyalist commander John Butler and some Indian allies massacred the Connecticut settlers. Perhaps this is why the land claim conflict was finally decided in favor of Pennsylvania. (6)

Abraham Clark (1726-1794) of New Jersey was a

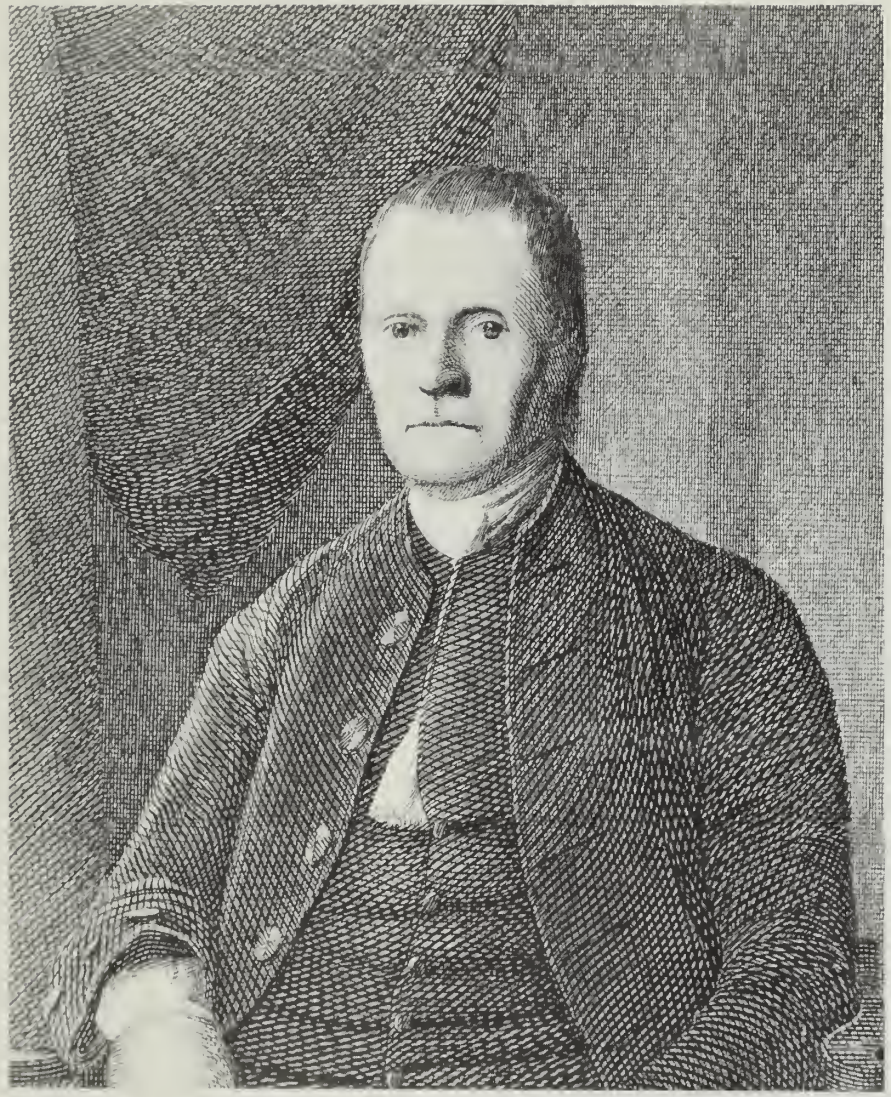
surveyor, but is better remembered for having signed the Declaration of Independence. Roger Sherman (1721-1793) also signed it. He was a county surveyor in Connecticut from 1745 to 1758. He is the only person who signed all four of the documents used in founding this nation; the Articles of Association (1774), the Declaration of Independence (1776), the Articles of Confederation (1781), and the Constitution (1787). (103)

Joshua Fry was another of the colonial surveyors. He was born in England, but emigrated to Virginia about 1720. He had been a student at Oxford for a year or two before that. He surveyed along the Carolina border with the deputy surveyor of Albemarle County, Peter Jefferson. Peter was Thomas Jefferson's father. When Fry was professor of mathematics at William and Mary College, he approved the registration as the Culpepper county surveyor, of a gangly 17-year-old kid (100) named George Washington. (102)

George Washington was already an experienced surveyor. When he was only 16 he crossed the Blue Mountains with veteran surveyor, James Genn. They surveyed land for Lord Fairfax in 1747 and 1748. (100) Another surveyor, Thomas Marshall (1730-1802), also worked on the Fairfax surveys. He was the father of John Marshall, who became a distinguished Chief Justice of the United States. (103)

In the early 1750's, Colonel Fry led the Virginia militia against the French. He grew ill with fever and died on the last of May, 1754. Lt. Col. George Washington was named his successor. Washington's leadership on the campaign made his name well known in the colonies. (102)

George Washington as a surveyor.

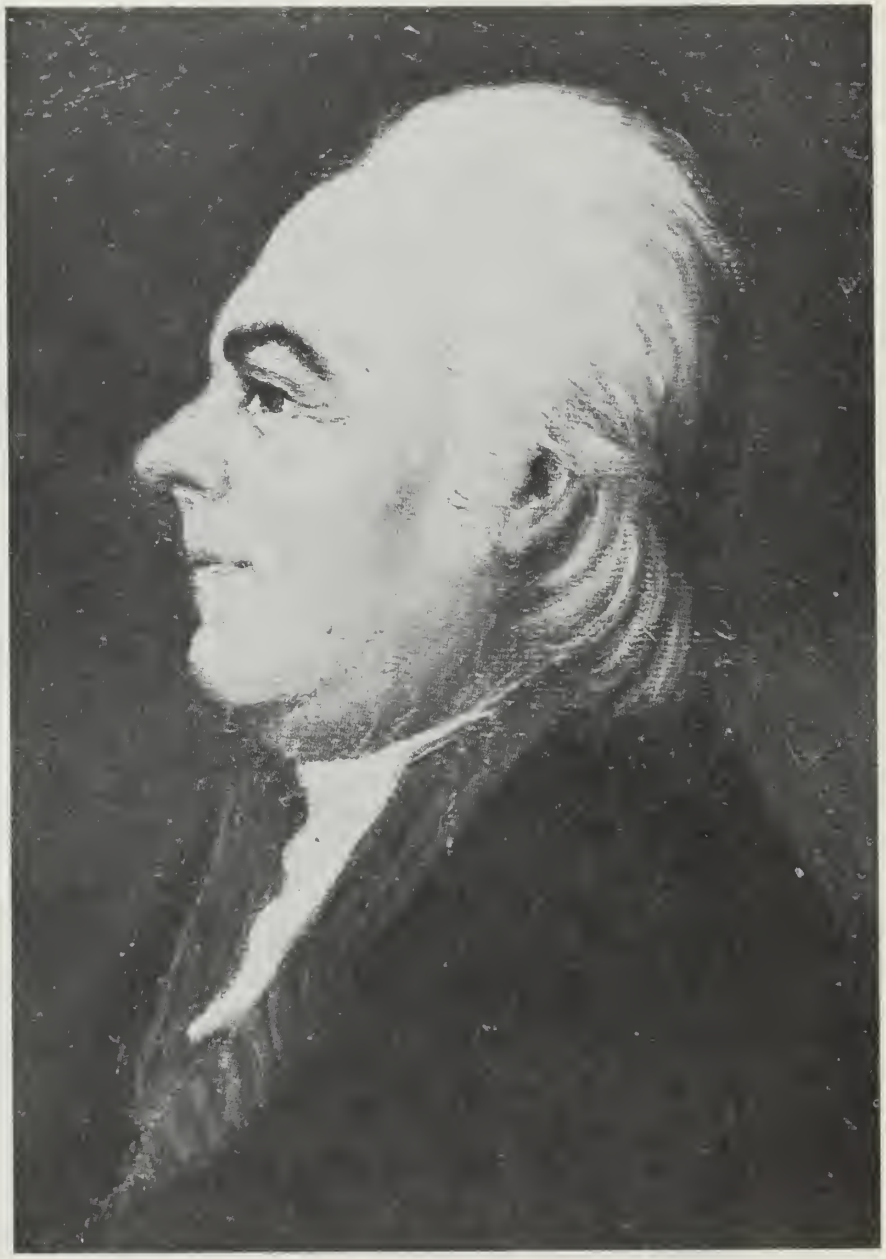


Roger Sherman became the surveyor of Litchfield County, Connecticut, in 1745. In Volume 3 of a work entitled, "Biography of the Signers of the Declaration of Independence" (which was published by R. W. Pomeroy, Philadelphia, 1823), it is mentioned that, though brilliant, Roger Sherman often seemed bashful and embarrassed in large gatherings. He was said to be taller than average, "erect and well proportioned, his complexion very fair, and his countenance manly, and agreeable . . . ." Apparently ladies found him agreeable and not too bashful; his biography states that he had two wives and fathered 15 children.

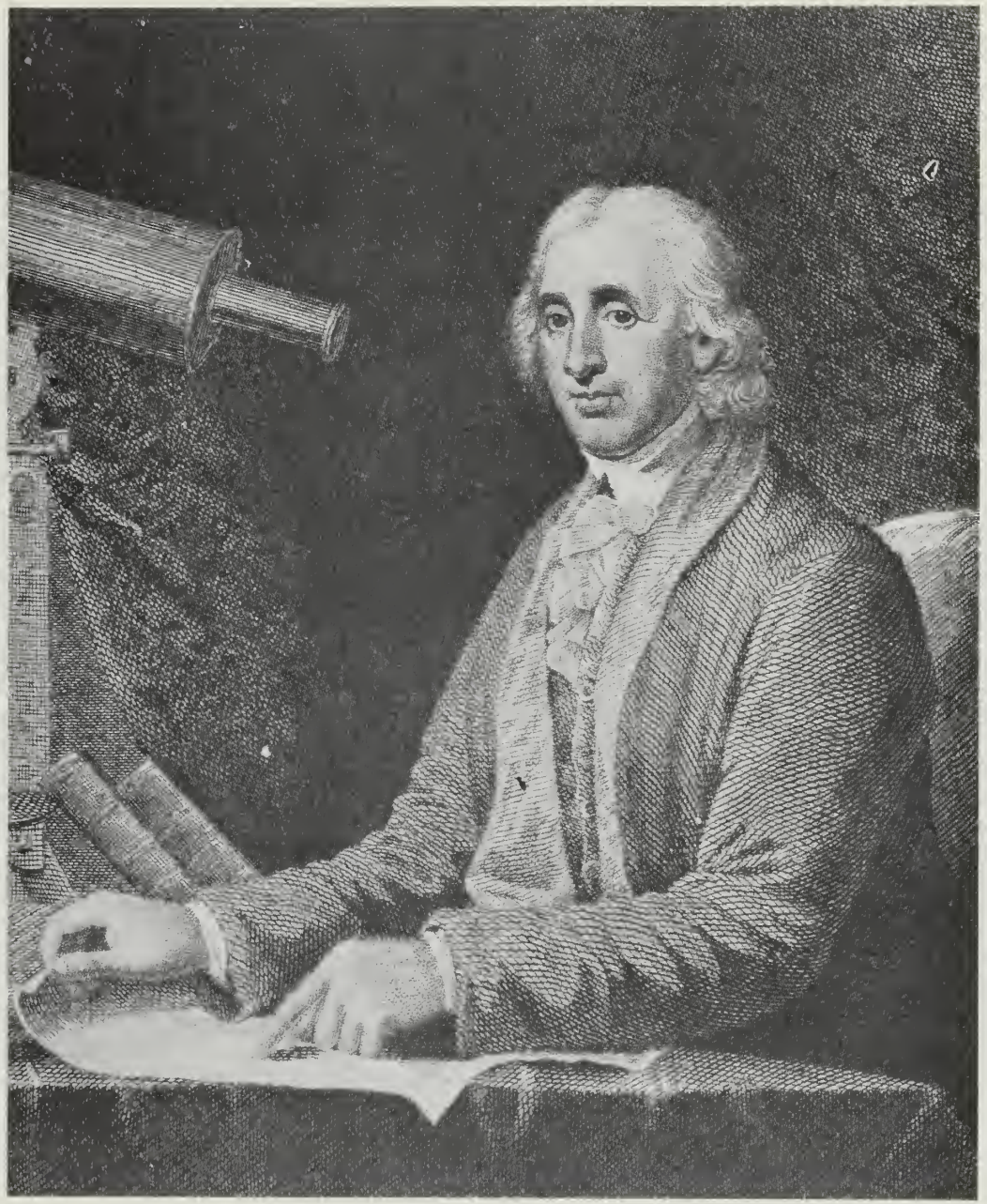
Benjamin Bannaker's
PENNSYLVANIA, DELAWARE, MARYLAND, AND VIRGINIA
ALMANAC,
FOR THE
YEAR of our LORD 1795;
Being the Third after Leap-Year.

—PRINTED FOR—
And Sold by JOHN FISHER, *Stationer.*
BALTIMORE.

Portrait of Benjamin Bannaker on the cover of his 1795 almanac.



Portrait of Andrew Ellicott.



Engraved portrait of David Rittenhouse.

Township 5, First Range,
Old Seven Ranges
Surveyed by
Absalom Martin
of New Jersey in 1786.

THE MASON - DIXON LINE

"He measured the north side, five hundred reeds, with the measuring reed round about." **Ezekiel 42:17**

"He measured the south side, five hundred reeds, with the measuring reed." **Ezekiel 42:18**

The Mason-Dixon Line has become the boundary that stands for the division between the Blue and the Gray during the Civil War. Since it is the east-west line separating Maryland and Pennsylvania, with a part extending south and east to divide Maryland and Delaware, it is hard to see why it was given this place in history. The three states all fought on the Union side. (97)

Its real place in history goes back much farther. In the middle of the 17th century, the rich land of the peninsula between Chesapeake Bay and Delaware Bay was claimed by both the Calverts of Maryland and the government of the Netherlands. When the Dutch were compelled to leave, the dispute was carried on by William Penn. The charters of Penn and Lord Baltimore were open to interpretation, which caused quarrels so bitter that the disagreement went on decade after decade.

After generations of bickering, a compromise decision, by England's Court of Chancery, gave Maryland most of the peninsula. Pennsylvania was to keep the northeast part, which later

became Delaware. The agreement was signed and work was started by local surveyors in 1760. (97)

The whole thing had been going on for more than a hundred years, but Penn and Lord Baltimore were suddenly anxious to get it settled. The work was not going fast enough to suit them, so they decided to hire Charles Mason and Jeremiah Dixon to get on with it. (31)

Mason was 35 years old, and held the post of assistant astronomer at Greenwich Observatory in England. Dixon, also an astronomer, mathematician, and surveyor, was 5 years younger. (97) They reached Philadelphia in the middle of November 1763, and were met by the commissioners of Maryland and Pennsylvania. (31)

They took oaths to do the survey, and checked the work already done. They found it accurate. In January 1764, they established their headquarters at the Harlan farm. This was near the farm of a local surveyor named Joel Baily. He requested work on the survey and was hired. He was with Mason and Dixon until they ended their survey in 1768. (5)

When the weather improved, the surveyors went south from Harlan's farm along a meridian. Distance measurements were taken as they went along, by chain, on level ground, and by levels on slopes. They set a post in a field on Alexander Bryan's farm, and marked it "West". It marked the latitude 15 miles south of the South Point of Philadelphia. The post was the reference point for the parallel of latitude that divides Pennsylvania and Maryland. (31)

The large survey party set heavy boundary markers at 5-mile intervals. These stones had the Penn coat of arms on one side and the Calvert coat of arms on the other. Smaller stones, marked 'P' on one side and 'M' on the opposite side, were also set along the line. (97)

The West Line, as they called the parallel between Pennsylvania and Maryland, extended to the summit of the Alleghenies by the time the winter of 1766-67 grew cold. It also went eastward to the Delaware shore. (31)

There was only Indian country west of the Alleghenies. They had to wait, the following spring, until an escort could be obtained from the Indians of the Six Nations so that they might continue the survey. All that spring and summer they continued the survey. The West Line reached the Monongahela at the end of September.

Twenty-six of their men quit the day they crossed the Monongahela River. The Shawnee and Delaware Indians held the land beyond that point. They went on until they had crossed a 'war path', and reached the top of a great dividing ridge. The termination point was noted in Mason's diary on October 18. It reads: "On top of very lofty ridge at 233 miles, 17 chains, 48 links from the Post marked West in Mr. Bryan's field, we set up a Post." (31)

Mason and his quiet, Quaker co-worker, Dixon, (97) handed the boundary map to the commissioners on January 29, 1768. (31)

The survey project lasted 4 years and was the biggest surveying accomplishment in Colonial America. The Mason-Dixon Line is probably the best known boundary in this country, even if it is known for the wrong reason. The survey cost just $75,000, and was amazingly accurate. An elaborate resurvey a few years ago showed a difference in latitude of only 2.3 seconds. (97)

THE TRANSITION

"And he brought me thither, and, behold, there was a man, whose appearance was like the appearance of brass, with a line of flax in his hand, and a measuring reed; and he stood in the gate:"

Ezekiel 40:3

Some of the very early American surveyors do not really fit into either the colonial period, or the period following the Revolutionary War. The Rittenhouse brothers, for example, were surveyors during both times.

To David and Benjamin Rittenhouse must go a large share of the credit for elevating the colonial art of surveying to the far more scientific art it became as the United States emerged as a nation. (103)

David Rittenhouse was born at Paper Mill Run, near Germantown, Pennsylvania, in early April 1732. (31) Pictures of him, such as a portrait by Charles Wilson Peale, show him as an adult with long hair, a thoughtful face, and deep set eyes. He is shown wearing the garb of an 18th century Philadelphia gentleman.

In his earlier years, though, he was an obscure young country Quaker, who grew up on his father's farm, and then became a farmer himself. Later he made clocks and surveying instruments, which he used in his jobs as a

local surveyor. David Rittenhouse taught himself how to do these useful things. He had always been a brilliant and curious-minded person who, in spite of the limited schooling available to Pennsylvania farm kids of his time, mastered astronomy, mathematics, and Newton's Principia. He was the designer and maker of the first magnetic declination arc for a surveyor's compass, and he was the first American to put a spider web, for crosshairs, at the focus of a telescope. He calculated the transit of Venus in 1769, and observed it with instruments he had designed and built. When the reports of his observations were known, David Rittenhouse was no longer obscure. He was an internationally famous astronomer, and was persuaded to move to Philadelphia.

His first surveying job of any note was a boundary survey for William Penn. It was David Rittenhouse who laid out the 12-mile radius around Newcastle, Delaware, which forms the part of the boundary that Mason and Dixon found so accurate that they incorporated it into their own survey. (31) This work was done with instruments he made for himself, several years before he achieved fame. (5)

Over a period of years, he surveyed boundaries for over half of the Thirteen Original States. His younger brother, Benjamin, was also a surveyor, and a very good one. Both of them were known for making the finest of surveying instruments. (103)

In 1796, by order of Congress, Benjamin, who later became an associate judge, made a surveyor's chain. Afterward this chain was used as the standard of the United States Land Office. (31) The respect accorded the Rittenhouse brothers was evidenced by the 1815 "Instructions For Deputy Surveyors", issued by Surveyor General Edward Tiffin. These instructions required both "a good compass of Rittenhouse construction", and the adjustment "by the standard chain", of "a two pole chain of 50 links."

Several of the surveying instruments made by the Rittenhouse brothers are now in valuable and admired museum collections. Among these

are two surveyor's compasses that were made for George Washington.

David Rittenhouse was appointed the first director of the Mint by Washington, in 1792. He died in 1796, but streets, a social club, parks, a school, and a scientific body all have his name, and clocks made by him probably still keep accurate time. (31)

Andrew Porter was also a soldier in the Revolutionary Army. He was a surveyor noted for his precise and excellent work. He served as one of the boundary commissioners on the survey of the Virginia-Pennsylvania boundary in 1784 and 1785. Porter was present at an event which will be described later, the setting of the stake that became the "point of beginning" of the rectangular surveys in this country. David Rittenhouse was also a Pennsylvania boundary commissioner on this important survey.

In 1800, Andrew Porter was sent to do the survey to settle the Wyoming Valley conflict. He became the Surveyor-General of Pennsylvania 9 years later. (103)

Robert Erskine was born in Scotland and educated there as a surveyor and engineer. He lived in England until about 1771. He was then made manager of the holdings of the American Iron Company in the northern part of New Jersey. He was about 36 years old when he arrived in America.

A few years later the 13 colonies declared their independence. Erskine did not go back to England. Instead, he joined the militia. When George Washington heard about his surveying background he asked him to serve as Geographer of the Continental Army. He accepted the job, and surveyed and made topographic maps of the Hudson-Highlands region. These maps were used in the successful campaign to keep New England from being cut off from the other colonies, and to defend the area and keep the Americans in control. Robert Erskine did not live to see the new republic he had helped to bring into being.

Thomas Hutchins was appointed as Erskine's successor in 1781. (103)

THE BEGINNING OF THE RECTANGULAR SURVEYS

"Give out from among you three men for each tribe: and I will send them, and they shall rise, and go through the land, and describe it according to the inheritance of them; and they shall come again to me." Joshua 18:4

About 1 month after the Declaration of Independence was signed, the Continental Congress offered deserters from the British Army, including the Hessian mercenaries, American citizenship and 50 acres of public land. A little over a month after that, an act was passed promising land bounties for naval and military services during the Revolutionary War. Land warrants were issued later to veterans; and land, over two and a half million acres of public land in the Northwest Territory (Ohio), was reserved as a "military district". (1)

The Thirteen Original States, and the land that is now the States of Maine, Vermont, Tennessee, West Virginia, and Kentucky, was never a part of the public domain of the United States. Kentucky and Tennessee were formed out of territory once claimed by Virginia and North Carolina respectively. Maine was part of Massachusetts until 1820, and Vermont, until admitted as a State in 1791, (37) was the subject of the conflicting claims of its neighboring states. West Virginia was separated from Virginia and became a State in

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1863, by act of Congress. All of these states kept title to the unappropriated, vacant lands inside their borders. (37)

Even before the preliminary peace treaty was signed at the close of the Revolutionary War, the Congress was faced with debts, expenses, conflicting colonial claims to western lands, no money, and the duty of providing a financial policy and a plan for settlement, if this new nation was to survive.

Seven of the colonies claimed jurisdiction over portions of the vast, unoccupied, somewhat nebulous area called "the western lands". No one was able to state, with any conviction, just where the colonial boundaries lay. The six colonies which had no charter claim to this land felt that, as it had been won by common effort, it should be held in common. The new national government, looking upon the lands as revenue producing assets, agreed with this point of view.

New York unconditionally ceded all her western land claims to Congress in 1780. Following this, Virginia and Connecticut gave up control over Ohio. Congress, however, permitted them to retain title to certain areas. Massachusetts preceded Connecticut in giving up her claim. South Carolina relinquished her claims in 1787; North Carolina in 1790. Georgia held out the longest. In reading the conditions of her cession, (20) it is apparent that her inability to cope with the Indians and settle the land without the aid of the Government was largely responsible for Georgia finally granting a deed of cession in 1802.

The most complicated of the state claims was taken care of with Virginia's cession. This put the new Government in the awkward position of being much too poor to maintain a capital, but in charge of a vast public domain. Congress had agreed that the land should "be disposed of for the common benefit of the United States". (8) Benefit could be derived in two ways. The land, as much of it as possible, could be sold for the highest possible price; or it could be surveyed and pioneers could be encouraged to buy and settle the land, making it

possible to hold it against foreign claims and Indians.

This was the situation in the spring of 1784, when Congress appointed a committee to develop a plan for locating and selling the western lands. Thomas Jefferson was the chairman of the committee, and the report delivered to Congress that year is in his handwriting. (30)

Nearly a year went by before anything more was done. Jefferson's report was read and reread. Another committee was appointed, this time with a member from each state. Jefferson had gone to Europe, so William Grayson took his place as the representative from Virginia. This committee amended the first report. Notably, townships were not to be 10 miles square. They were to be 7 miles square. (8)

Congress, at this point, did some amending of its own. The size of townships was reduced to 6 miles square. The part of Jefferson's report calling for surveys before sales, and for the lines of these surveys to be run and marked due north and south, with other lines crossing these at right angles, was retained. Townships were to be subdivided into lots 1 mile square, in the same direction as the external lines. They were to be numbered from 1 to 36. There was no mention of which corner section was to be section number 1.

The first public land survey area is in Ohio. It is known as "The Seven Ranges", because Congress directed that there was to be no part of the tract opened for settlement until seven ranges had been surveyed. In "The Seven Ranges", sections were numbered from 1 to 36, with number 1 in the southeast corner. The numbers ran from south to north in each range, as they do in some other parts of Ohio, such as the "Between the Miami Rivers" survey area. The system of numbering was changed in 1796 to the one we use now, with section number 1 in the northeast corner of the township.

The Canadian system of land subdivision is in some ways patterned upon that of the United States, but section number 1 is in the southeast corner of their townships. (10) Both American and Canadian section numbers run in

Numbering of Sections

36	30	24	18	12	6
35	29	23	17	11	5
34	28	22	16	10	4
33	27	21	15	9	3
32	26	20	14	8	2
31	25	19	13	7	1

System used under Ordinonce of Moy 20, 1785

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Act of Moy 18, 1796

31	32	33	34	35	36
30	29	28	27	26	25
19	20	21	22	23	24
18	17	16	15	14	13
7	8	9	10	11	12
6	5	4	3	2	1

System used in Conodo's Dominion, or public, londs. The dimensions of Conadion townships usuolly differ from those of the United Stotes due to their provision for roodwoys between or within sections.

opposite directions in alternate lines. The Greeks have a word, boustrophedonic, for this style of writing. Its literal translation is turning like oxen in plowing.

The first land ordinance was passed on May 20, 1785. Under its terms, Congress was to appoint surveyors, one from each state, to serve under the direction of the Geographer. Also included was the remarkable provision that, in each township, section 16 would be set aside for the maintenance of public schools.

The Geographer was empowered to give oaths to the surveyors appointed to serve under his instructions. They were to swear to do their duty faithfully. The chainmen on the survey crews were to take a similar oath.

The surveyors were instructed, under the ordinance, to measure their lines with a chain, mark them "with chaps on the trees", describe them exactly upon a plat upon which they were to note, "at their proper distances, all mines, salt springs, salt licks, mill seats, that shall come to his knowledge; and all

water courses, mountains, and other remarkable and permanent things over or near which lines shall pass, and also the quality of the lands".

Thomas Hutchins was chosen to direct the surveys under the Ordinance of 1785. He was born in Monmouth County, New Jersey. While he was little more than a boy, he went to the frontier, the "western country". Hutchins served, at times, with the Pennsylvania Colonial Troops. It was during these years that he acquired an education in surveying and engineering.

Hutchins was Col. Henry Bouquet's assistant, in 1764, when Bouquet directed the course of a military expedition against the Indians. An account of the conflict, "Historical Account of Bouquet's Expedition Against the Ohio Indian in 1764", was published and contains a plan for frontier settlement. The plan very closely resembles the system of land subdivision adopted by the United States. No author is given credit for the plan, since it is not in the main text of the account. (10)

Some authorities give Bouquet credit for the plan. He was a Swiss who had served in Holland and in Sardinia. There was, during the 17th century, a limited system of rectangular survey in Holland (36) and this is held as evidence that he was the author. (32)

Other authorities are equally sure that Thomas Hutchins was the originator of the plan. (10) They cite the fact that he was in the habit of keeping records of his travels and his work. He had been employed to lay out plans for a number of military works. Military establishments had long been laid out in a rectangular manner.

Hutchins served at Fort Pitt, as a British officer, and made exploratory journeys from there north to Lake Erie and overland to Lake Michigan and the upper Wabash valley. His expeditions also took him down the Ohio River and to the Mississippi. He compiled a general map of the west as a result of these travels. This map established him as an authority on the area. (11)

Hutchins had attained the rank of captain of the 60th Foot or Royal American Regiment of the British Army by the time the Revolutionary War was declared. (35)

He was in London at the beginning of the war, and the British, quite naturally, planned to put his experience to work. After all, he was the British Army's leading expert on the American frontier.

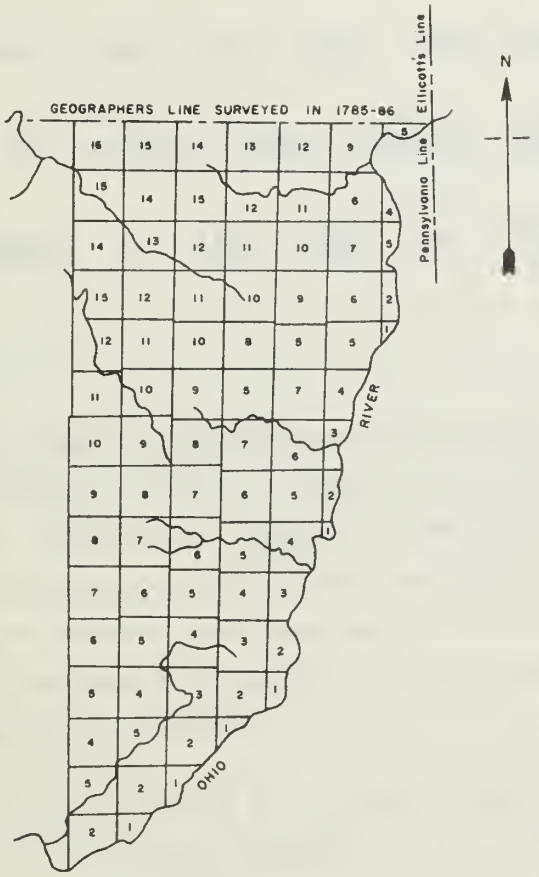
They had forgotten one important thing. Hutchins was an American. He refused to fight against other Americans. This upset the British so much that they put him into prison for treason. (101)

When he was released, in 1780, he contacted Benjamin Franklin, who was in France. Through Franklin, arrangements were made for him to return to the United States. He was given the rank of captain and succeeded Erskine as Geographer of the Continental Army in 1781. (35)

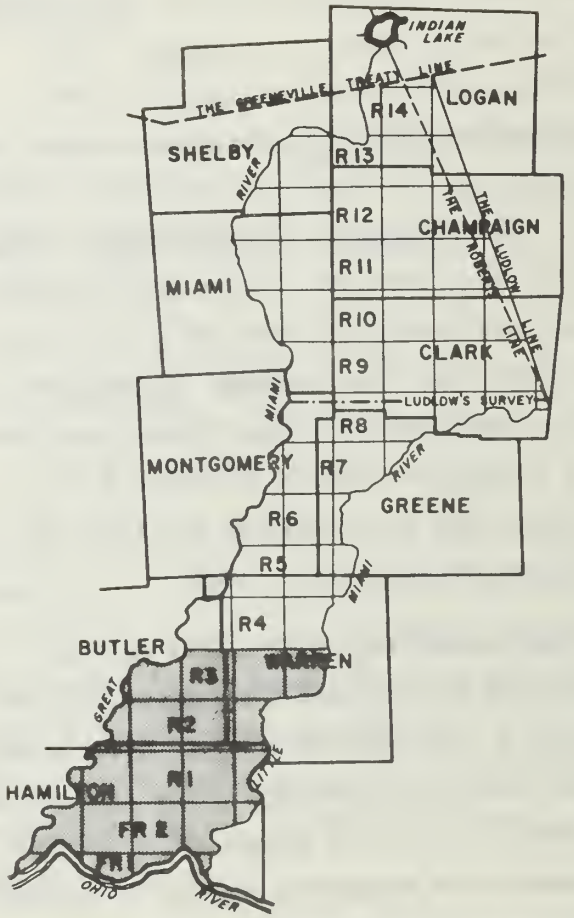
Two years later he was commissioned by the State of Pennsylvania to extend the survey from the western end of the Mason-Dixon Line to the point which was to be the southwest corner of the state, and from there to survey the west boundary of Pennsylvania north to the Ohio River. The line was to be the boundary between Pennsylvania and Virginia, so Virginia also appointed surveyors Andrew Ellicott and Joseph Neville. (49) There were, in fact, three men from each state on this particular survey. (110) The two others from Pennsylvania were David Rittenhouse and Andrew Porter. (110)

The survey marking the south boundary of Pennsylvania was completed in 1784. Before the west boundary survey began the following year, Hutchins was told his services as Geographer would be needed. Soon the Land Ordinance of May 20, 1785 was passed. It called for the survey of the public lands to begin "...on the River Ohio at a point that should be found to be due north from the western terminus of a line which has been run as the southern boundary of the State of Pennsylvania."

Four boundary surveyors, David Rittenhouse and Andrew Porter, who had been commissioned by



The Old Seven Ranges, surveyed under the ordinance of May 20, 1785.



The private survey of the Symmes Purchase (shaded area) was the basis of a unique Ohio public land survey. In the "Between the Miami Rivers" survey area, townships are numbered eastward from the Great Miami River and ranges are numbered northward.

Pennsylvania, and Andrew Ellicott and Joseph Neville, who surveyed for Virginia, (28) established this point on August 20, 1785. Andrew Porter, following their arrival on the south bank of the Ohio, near the mouth of Mill Creek, noted the event: "This morning continued the Vista over the hill on the south side of the River and set a stake on it by the signals, about two miles in front of the Instrument, brought the Instrument forward and fixed it on a high post, opened the Vista down to the River, and set a stake on the flat, the north side of the River." (110)

Hutchins, named Geographer of the United States, was to "personally attend to the running of" a line westward from the newly established "point of beginning". This line extends the width of the Seven Ranges, 42 miles, and is known as the Geographer's Line. Later surveys show it to be about 1,500 feet south of its intended position at the western end. (110) Even so, it was the first line surveyed under the rectangular system of the United States. It was the start of the most magnificent cadastral survey project in history.

THE SEVEN RANGES

"And the men went and passed through the land, and described it by cities into seven parts in a book, and came again to Joshua to the host at Shiloh."

Joshua 18:9

The rectangular survey system adopted under the Ordinance of 1785 is a marvel of simplicity. Because of the system, and the cadastral surveyors who changed it from a plan on paper to regular lines upon the land, the swift and orderly settlement of a vast public domain became a reality.

Separate large pieces of the public domain are, in themselves, tremendous survey areas. There are 31 principal meridians and base lines in the conterminous United States and 5 in Alaska. The intersection of these two lines is the initial point of each of the survey areas. Some of the principal meridians are numbered and the rest have proper names. The numbered ones go only to the Sixth Principal Meridian. Most of the names give a clue as to the area they govern; for example, Boise Meridian, New Mexico Principal Meridian, or Humboldt Meridian.

Townships are numbered north or south of the base line. A line or column of townships is called a range, and they are numbered east or west of the principal meridian.

At the beginning of the rectangular system no provision was made for the convergence of meridians. At a later time standard parallels and guide meridians were included in the plan.

Each of these 6-mile square townships is divided into 1-mile square sections, numbered from 1 to 36. These numbered sections may be further divided into aliquot parts, and thus easily described and identified. The southeast quarter of the southeast quarter of the southeast quarter of section number 5, in Township 2 North, Range 3 West, of the Boise Meridian, describes one piece of land, and one piece of land only. The description even tells the initiated how many acres are being described. The familiar Bureau of Land Management abbreviation for this particular property is: SE¼ SE¼ SE¼ sec. 5, T. 2 N., R. 3 W., Boise, Mer.

This simple and straightforward system of cadastral surveying provided an attraction strong enough to bring millions of people to this country in the hope that they might share in the ownership of land.

Between 1850 and 1900 the number of farms in this country increased from less than a million and a half to more than five and one half million. By avoiding the disputes and conflicts inherent in a metes and bounds system, much time, litigation and bloodshed was also avoided. (8)

All of this began when the first United States Government survey party, under the direction of Thomas Hutchins, met at Pittsburgh where teamsters, horses, and supplies had been gathered. There were to have been 13 surveyors, one from each state, but only eight actually began the survey.

Hutchins, Edward Dowse, for New Hampshire; Benjamin Tupper, for Massachusetts; Isaac Sherman, for Connecticut; Absalom Martin, for New Jersey; William W. Morris, for New York; Alexander Parker, for Virginia; James Simpson, for Maryland; and Robert Johnston, for Georgia, with the rest of the party, moved downstream to camp at the mouth of Beaver Creek, near the point of beginning. (89)

The last day of September, starting at the initial point, Hutchins personally supervised the start of the first east-west line.

On the 8th of October, after having covered just 4 miles of the base line, work was halted. The report of the work stoppage for the season spoke of "disagreeable intelligence concerning the Indians." (111)

Apparently the "intelligence concerning the Indians" was more agreeable by the following spring, because Major Winthrop Sargent tried to get an appointment as a surveyor at that time. Sargent was from Massachusetts, and had been a distinguished artillery officer in the Revolutionary War. He, along with many other soldiers, had suffered financial reverses while he was busy fighting. Some of these veterans joined together in organizing the Ohio Company of Associates, which planned settlement in the western country. He was elected secretary of the group. (74)

General Henry Knox, then Secretary of War, was an old army buddy of his, so he went to him about securing the appointment. Knox told him that the appointments had been made, but that they might need more surveyors.

Knox and Hutchins agreed that Sargent would be a good man to have along. Hutchins had heard that the surveyor for North Carolina might not be able to accept. He advised Sargent to try for the vacancy, should it occur.

By June 11, Knox was sure there would be at least one vacancy, and wrote to Sargent suggesting that a man already in the area would have the best chance of getting the job. Sargent took the hint and started west toward Fort McIntosh. While he was on his way to the Fort, he was elected by Congress as the surveyor from New Hampshire, because Edward Dowse had resigned.

For the next few months, Sargent kept a diary. He began it on June 18, as he left Boston, and he ended it upon his return from the field, just before Christmas, 1786. John Mathews, later to become Sargent's assistant, also kept a log. They were unusual in this respect. Few of the

surveyors, there or on later surveys, bothered to keep a record other than their field notes.

On his trip west, Sargent stopped in Philadelphia long enough to visit and dine with Benjamin Franklin. Though he enjoyed this social encounter, he did not seem to be too happy with the rest of Pennsylvania. In Pittsburgh, which was a town of about 80 log huts, he stayed "at Smith's Tavern which tho' as good as any Place is bad enough and very extravagent."

Beyond Pittsburgh Sargent traveled with Major John F. Hamtramck, commander of Fort McIntosh. The day after their arrival Sargent crossed the river and reached the surveyor's camp opposite the mouth of Little Beaver Creek (74) where all of the other surveyors were assembled.

They drew lots to see who would survey which range. In August of 1786, 6 miles due west of the 'point of beginning', Absalom Martin, of New Jersey, started south on the survey of the first range. (101) He gained a small measure of fame, because he drew lot number one. Sargent drew number five. (74)

Danger from Indian attack was being discussed and the surveyors were not as optimistic as Hutchins. They requested troops to protect them. Hutchins arranged for military escort from Fort Harmer, because he did not want another time like his first try.

While Sargent waited for his supplies to arrive, he and some other old army friends got a chance to talk as the soldiers were on their way to Fort Harmer. Sargent was very bitter about his reverses during the war, and the treatment he had received afterward. He wanted very much to settle in the 'western country'.

Since his supplies had not yet been received, and it appeared that there would be several days before work could start, Sargent went with his friends on their trip to Fort Harmer.

They went by river, and a beautiful journey it must have been. The land they saw along their way was rich and level, yet not wet or too low. Sargent could picture cattle grazing in the

luxuriant meadows. The trees along the banks of the river were majestic oaks and walnuts. Hickory and maple trees of huge proportions were also noted.

He mentioned the corn on Zane's Island, planted in May and already 12 feet high! This island was named for Colonel Ebenezer Zane. He and his brothers and his sister were made famous in the 20th century by a descendant of theirs, Zane Grey. Mr. Grey inherited diaries and papers and wrote at least three books about his illustrious forefathers and their lives on the Ohio frontier in the 1770's and 1780's.

Sargent seemed to really appreciate the country, but not the squatters. He spoke of some of them living on the north shore of the river, in an area he would have liked for the Ohio Company settlement, as, "lawless banditti". This attitude did not contribute much to his popularity with these people, who thought of themselves as pioneers.

The days of rest, with time for exploring the country, came to an end when the chainmen and packers and horses reached camp. The pay for the men was a "half Joe" each per month and 30 shillings per head for the horses. A half Joe was a Portugese gold coin which equalled $8!

The work actually began on September 2, 1786. Dense swamps and thick undergrowth made progress slow. In many places the only way to get through was to cut a line every rod of the distance. There were not enough men and their instruments lacked modern refinement. These first surveys did have inaccuracies; but considering the odds the men worked against, they were very well done indeed.

In reaching his own range, the fifth, Sargent spoke of the others. The first range was "tolerably good but a little broken"; the next was "fine lands, by no means high, but level"; for the third, "extreme bad-broken and some very high hills"; the fourth range he called "good lands". His range lay beyond these others and was covered with thick underbrush. At times not more than 2 miles a day progress could be made with the surveying. For this

work the surveyor received, including all expenses, $2 per mile.

When Sargent had run the east-west line of his range he was asked to run Simpson's on the sixth range. He completed it and returned to work on the fifth range.

About this time a rumor of a large band of Shawnee Indians was being circulated. The report caused Hutchins and the surveyors with him to return to camp. Sargent didn't believe the report. He had not seen any Indians, and even if there were any, he couldn't see that he should behave any differently than when he was in the army and exposed to danger every day. He and his crew stayed on the job, and he wrote a letter to Hamtramck asking if there were any truth to the whole thing. The last line of the letter tells of his plan to go on west until he received an answer. Fortunately, the rumor, this time, was false.

There were many problems that were all too true, however. One of these was the shortage of meat for the party. A hunter was assigned to them to help with that situation. Rattlesnakes, wolves, and the screams of wild cats were less than pleasant at times, but Sargent seemed to like his work in spite of these disturbing things.

By September 25, the rumors of Indian hostilities had become alarming. Sargent and his crew went back to the camp at the mouth of Little Beaver creek. Hutchins had called all the men together there to consult with them about the work. Sargent was of the opinion that, since they had not been attacked, they should not have stopped work. He was sure it would be taken as a sign of weakness by the Indians.

Hutchins told the assembled survey crews that he thought four ranges should be completed. Work beyond that range, he left up to a vote by the surveyors. The surveyors talked it over and voted that it was too dangerous to go beyond the fourth range. Sargent did not agree. He also did not agree with the manner in which Hutchins had handled the situation. His diary entry on September 28 shows his annoyance.

"For my part, I would prefer to receive and obey order, rather than decide for myself and I am sorry to find Mr. Hutchins, who is our principal so fond of council and so wanting in decision. He is a good character, a worthy man, but stands in need of confidence in himself -- which we (surveyors) have all very sensibly felt, and which has sometimes involved us in disagreeable altercations and disputes about modes and forms and the more essentials of our duties."

Isaac Sherman, third range, and Ebenezer Sproat, fourth range, had the option of returning to their work. Sargent asked for a similar privilege. Hutchins refused to order him to resume surveying, but agreed to let him if he chose to do so. Sargent requested a military escort and went back to the field. The men were getting a little worried, but Sargent was not to be turned aside. He wanted to finish the south line to the river and take the meanders of the Ohio. This would allow the sale of one range more than Hutchins had planned.

To accomplish his goal he hired more men. One of the new men was John Mathews, a well educated New England schoolteacher, who had not been able to find a teaching job. As was true of many of the men on early survey crews, he was attracted by the idea of adventure on the frontier. He became a chainman, in a party now numbering 36. The march from camp back to the survey area was a slow one, but by the middle of October they were again at work.

Sometimes Sargent found the escort of troopers more trouble than it was worth. They were not well equipped for the work and lacked proper clothing. Sargent sympathized with them and would have dismissed them except for the fact that his hunter became convinced that Indians were nearby.

When all the horses, except one poor one, were stolen, it became apparent that the hunter was right. Without the horses the work became far more exhausting. Then the weather turned bad and the men started to hint that they had done all the surveying they wanted to for one season. Even Sargent started to feel apprehensive.

With the completion of the seventh township on November 5th, Sargent returned to the surveyor's camp. Hutchins now wished Sargent to finish the range. This made Sargent even more critical of Hutchins.

Before he could return to the field, word was received from General Richard Butler, the superintendent of Indian Affairs. The Indians demanded that the surveyors halt work. Since the weather was so bad anyway, they decided to stop the survey for the year.

Hutchins reported to Congress that four ranges and seven townships in the fifth range had been completed. About 800,000 acres had been surveyed and were ready for sale as a result of the seasons work.

The surveyors, including Sargent, sent a memorial to Congress asking for a provision to pay them for their expenses in the past and to increase their pay in the future. They said that they would take a part of this in land. Sargent's actual expenses were $250,000 and his pay, at $2 per mile, was $120,000.

Sargent had felt that his efforts were not appreciated by Hutchins, but a comment Hutchins wrote showed quite the opposite. In it he spoke of the fact that Sargent had exerted himself to the best of his abilities for the 'Public Good' and that he had lamented being unable to finish his range.

Sargent wrote to Hutchins the following year offering his services to complete the fifth range. There were enough surveyors already at work that year and it was not necessary for him to cross the mountains.

After the Ordinance of 1787 encouraging mass settlement was passed, Sargent was elected secretary of the Territory Northwest of the Ohio River. He was acting governor much of the time during the 10 years he served in this office. He left the old Northwest Territory in 1798 after accepting an appointment as governor of the just-organized Mississippi Territory. (74)

THE ELLICOTTS AND BENJAMIN BANNEKER

"And the city lieth foursquare, and the length is as large as the breadth: and he measured the city with the reed, twelve thousand furlongs. The length and the breadth and the height of it are equal." Revelation 21:16

On the last day of April 1790, George Washington became President of the United States under the new Constitution. This was just 2 days after the death of Thomas Hutchins, the man responsible for the survey which had been, undoubtedly, the most significant project under the Confederation. Now, however, there was another project to think about. This nation was, at last, to have a Constitutional Capital, the City of Washington. Jefferson and Hamilton made a political agreement to move the capital to Philadelphia from New York in 1790, where it was to remain for 10 years. Following that, the capital was to be located in the 10-mile square tract of federal land near the place where the Anacostia River joined the Potomac.

In February 1791, Secretary of State Jefferson, at President Washington's suggestion, asked Andrew Ellicott to go "by the first stage to the Federal Territory on the Potomac for the purpose of making a survey of it." (105)

It is not surprising that Andrew Ellicott was the surveyor designated to do this important

work. At the time he was, perhaps, the most highly regarded surveyor in the United States. He, and his brothers, had lived not far from the chosen site since about 1770. It was then that their father and two uncles settled on the Patapsco River some 10 miles east of Baltimore and built Ellicott's Mills, where Ellicott City is now located. Andrew was only 16, Joseph, Jr. was 10, and Benjamin just 5, when they left Bucks County, Pennsylvania where all of them were born. These Quaker boys were exceptionally good at mathematics, and all three of them became surveyors. They knew and admired the Rittenhouse brothers, and Andrew had studied under a highly respected Irish mathematics professor, Robert Patterson, in Pennsylvania. (104)

In spite of a boyhood filled with gentle Quaker teaching to the contrary, tall, large-framed Andrew joined the Elk Ridge Battalion of Militia and fought with them through the Revolutionary War. He attained the rank of Major, a title by which he was recognized all the rest of his life.

Soon after the war, he was appointed by Virginia as a member of the survey to continue the westward Mason-Dixon Line, which had been stopped by unfriendly Indians in 1767. In the following years he surveyed other boundary lines (5), including the meridian northward from the point of beginning on the north bank of the Ohio River. This Ohio-Pennsylvania boundary is called Ellicott's Line. (32) The line along the 31st Parallel, which will be discussed later, is called Ellicott's line of demarcation.

As Major Ellicott worked on the survey of the Federal Territory, Jefferson contacted the tempestuous, fiery-tempered Frenchman and American Revolutionary War veteran, Pierre Charles L'Enfant, "...to have drawings of the particular grounds most likely to be approved for the site of the Federal Town and buildings...connecting the whole with certain fixed points on the map Mr. Ellicott is preparing." (105)

Another brilliant surveyor-astronomer was hired to work on the preliminary survey of the capital site. He was Benjamin Banneker, (24) a friend of the Ellicott brothers and their cousin, George Ellicott. Benjamin Banneker

was a Negro. His mother was the oldest daughter of a white indentured servant named Molly Welsh and a Negro slave named Bannaky whom she purchased, freed, and married. Banneker's father was from Guinea, and he, too, had been a slave. (4) Banneker was born free, because the law said he was to follow the status of his mulatto mother, Mary, instead of that of Robert, his freedman father. Perhaps this law is the reason that Robert took Mary's name when they were married, instead of the other way about. When Benjamin Banneker was very young, people were impressed by his many interests and by the speed and ease with which he learned. For example, he was able to read by the time he was 4 years old. (24)

When Banneker was 6, probably in the late 1730's, his father bought a large farm about 10 miles from Baltimore, Maryland. Banneker was able, in his spare time, to attend the school of a Quaker farmer along with the other young people in the area. He soon surpassed the other students in mathematics, and amazed those who knew him with his unusual gifts. A trader gave him a watch, and from drawings made from it, he actually constructed a clock. Its frame and movements were entirely of wood. It was the first instrument of its type ever made in America. (24) Even though his clock was the wonder of the community, Banneker remained a farmer until he was well past 50 years old. (4)

When the Ellicotts moved to Maryland, Banneker helped in the construction of their mills. The wonderful wooden clock came to their attention, and they were pleased to help Banneker acquire the knowledge for which he hungered. The Ellicotts loaned him books, tools, and instruments. (5) More than that, they gave him their friendship. They all, but George perhaps most of all, encouraged him to pursue his solitary studies.

Banneker learned surveying and developed a dedicated interest in astronomy. He spent many nights studying the stars and their courses, and he became adept with his borrowed instruments. He learned to calculate ephemerides, and finished computing data for

his first almanac in the spring of 1790. Banneker, then nearly 60 years old, was disappointed because it was not published. Due to the Ellicotts' interest, the almanac came to the attention of the Pennsylvania Society for the Abolition of Slavery, and this led to publication, afterward, of later issues. (4)

According to an account by Silvio A. Bedini, in "Early American Scientific Instruments and Their Makers," (5) Benjamin Banneker, while assisting Ellicott in surveying the City of Washington, "completed his almanac and gave it to George Ellicott, Andrew's cousin, as a subject of possible interest. Apparently George Ellicott turned it over to the Honorable James McHenry of Baltimore, who in turned [sic] submitted it to the Philadelphia firm of Goddard & Angell, who published it....".

According to another account, also by Silvio A. Bedini, "Benjamin Banneker and the Survey of the District of Columbia, 1791," (4) after Banneker completed his work as scientific assistant to Major Ellicott during the preliminary survey of the Federal Territory, he returned to his home. He then set to work finishing his calculations for 1792. Banneker had started collecting data for this almanac while he was still working on the survey of the City of Washington, but he finished it in Baltimore County, and in June 1791, Elias Ellicott, George's brother, sent word to James Pemberton in Philadelphia that Banneker's ephemeris was ready to be printed.

The really important things are not who informed whom of the fact that Banneker's almanac was ready for the press, or whether he finished it in Washington City or at his farm home. The main facts are that he did assist Ellicott in surveying what is now the District of Columbia, and he did finish his almanac.

Banneker's place in history is firmly secured by the fact that he made the observations and calculations needed in the survey of the 10-mile square in which our nation's capital is situated. Adding to his stature is the fact that six of the ephemerides calculated by this largely self-instructed, white-haired Negro farmer were published, over a period of years, in nearly 30 different editions. (4)

The L'Enfant-Ellicott team made good headway on the survey and plans for the capital. Joseph and Benjamin Ellicott joined their brother on the project in late spring, 1791. Under L'Enfant, broad avenues took graceful shape, and the plans began to show a more and more beautiful city.

When L'Enfant submitted his plans for approval they were, mainly because of his demands, refused by Congress. He resigned and would not allow the plans to be used at all. (105)

In March 1792, Andrew Ellicott was placed in charge of finishing the job. He even revised and redrew L'Enfant's plan for the city. (5) It was accepted by Congress, and the final minor points of the project were completed by Major Ellicott's assistants. (105)

In 1793, Pennsylvania commissioned Andrew Ellicott, already gray-haired at the age of 39 (4), to locate a road and lay out the towns of Erie, Warren, and Franklin. It was a large and difficult task, but the Major finished it by the fall of 1796. (5) At about this same time, Joseph Ellicott was working on surveys for the Holland Land Company in the western part of New York. These surveys were of value, later, when people started talking about building the Erie Canal. Joseph also laid out a city he called New Amsterdam, (Buffalo, New York). (104)

President George Washington personally appointed Major Ellicott to work with the Spanish surveyors in running and marking the boundary line, determined by the treaty dated October 27, 1795, (5) between Mississippi Territory and Spanish Florida. The boundary was to be 31 degrees north latitude. A marker was set where the 31st parallel of north latitude intersected the Mississippi River, in what is now Mobile County, Alabama. Ellicott's stone, as it is called, is sandstone and measures some 2 feet in width. It is about 8 inches thick, and stands 2 feet above the ground. "U.S. Lat. 31, 1799" is cut deeply into its north side; the south side reads, "Domino de S.M. Carlos IV, Lat. 31, 1799". (92) Even though the stone was placed as a part of a

boundary survey, it was also the basis for a great many other surveys in the southern part of Alabama. Some of the distance measurements were, later, found long; (45) but as shown by the U.S. Coast and Geodetic survey marker set in the Ellicott Stone at a later time, in many respects the survey was an accurate one. The U.S. C. & G. S. values on it are:

Lat. 30° 59' 51.463"

Long. 88° 01' 21.076" (92)

The Georgia-North Carolina boundary was a controversial one. The dispute over it was settled in 1810, when Major Ellicott determined the 35th degree of north latitude. (31) Georgia had hired him to do the survey, and using either Rittenhouse instruments, or those made by himself or his brothers, he did his usual fine and honest job. His survey added land to North Carolina. This was not at all the news that Georgia wanted, so they did not pay him. (104)

Andrew Ellicott's last survey project was for the international border survey along the 45th parallel. More than a generation before, Governor Moore, of New York, had talked with Governor Murray at Quebec about the fact that it was about time someone located the 45th parallel on the ground. Surveyors from both areas surveyed independently. As a result, the New York surveyor marked the line farther south than his Canadian counterpart; however, the Canadian's line was accepted. Even earlier, Joseph Smith, for New York, and John Collins, for Quebec, surveyed eastward along the 45th parallel to the source of the Connecticut River. Some of the bills presented to cover "sundrys" on this survey included substantial amounts for rum, wine, and French brandy. (113)

Smith was succeeded by Thomas Valentine, but he became ill with "a Bilious complaint, attended with a Choke in my Bowels." Saulthier took over for Valentine in 1773, since the people in charge decided that the boundary survey could not be postponed while someone recovered from an attack of constipation. (113)

It was later, in 1817, that Andrew Ellicott was asked to lend his services to locate a portion of the United States-Canada boundary

in accordance with the fifth article of the Treaty of Ghent. In order to do this he was granted leave from West Point. President Madison had appointed him professor of mathematics there, in 1815. Major Ellicott still held this professorship at the time of his death in 1820. (5)

EARLY SURVEYS IN INDIANA

"Cursed be he that removeth his neighbor's landmark. And all the people shall say, Amen."

Deuteronomy 27:17

For the first 17 years the United States Government rectangular surveys were confined to the State of Ohio and the part of Indiana east of the Greeneville Treaty line. During this time, 1785 to 1802, some of the defects and limitations within the system were found and corrected by legislation.

Changes, other than that of the system of numbering sections, were brought about by the Act of May 18, 1796. The Geographer, who had died in 1789, was replaced by a Surveyor General. His salary was set at $2,000 a year. He was to hire deputies, without reference to states, and get on with the surveying.

The two provisions of prime interest to surveyors were the one that raised their pay from $2 to $3 per mile; and the one stating that, in alternate townships, alternate section lines were to be traced in the field. This formed 2-mile squares on the ground. Corners were to be set 1 mile apart on these lines, which gave each section three corners set in the field. Under the Ordinance of 1785, corners had been established by the surveyors along the

township lines, and section lines had been added on paper in the office. Understandably, this was not too successful.

Under Rufus Putnam, the first Surveyor General, two more acts of great importance to surveyors, were passed. The Act of March 1, 1800 involved a principle of surveying that was not exactly new; it can be found several times in the Bible. The Act is a bit wordy, and refers to the 5-mile townships surveyed for the "Society of the United Brethren for propagating the gospel among the heathen". What it says, in effect, is that a corner, set under regulations by a surveyor in the field, is a true corner. It is a true corner whether interior lines extended from it are parallel to the exterior lines or not. It is a true corner even if later surveys indicate that it was placed incorrectly.

This important principle of surveying was reinforced and applied to all public land surveys by the Act of February 11, 1805. Under its second section, it provided that "All the corners marked in the surveys....shall be established as the proper corners of sections, or subdivisions of sections, which they were intended to designate....".

The Act of May 10, 1800 provided for the subdivision of townships into half sections of 320 acres each. It also made provision for placing all excess or deficiency of measurement in the north mile and the west half mile in each township.

Under Putnam, Israel Ludlow ran the line north from the mouth of the Great Miami. (28) It was, later, named the First Principal Meridian. It divides Ohio and Indiana, and governs Indiana public land surveys east of the Greeneville Treaty line. This treaty line of August 3, 1795, extended from Fort Recovery, Ohio, "southwesterly in a direct line to the Ohio, so as to intersect that river opposite the mouth of the Kentucky or Cuttawa River." The area between this line and the First Principal Meridian, known as 'the Gore', was given to Indiana by the Ohio Enabling Act of April 30, 1802. (76)

The range line beginning at the confluence of the Ohio and Little Blue Rivers, and running to the northern boundary of Indiana, is the Second Principal Meridian. It covers all the rest of the public land surveys in Indiana.

Other surveys had been made in Indiana before Indian title was extinguished, but as title passed to the United States, the rectangular system of surveys was established.

In 1742, long before the United States surveys began, the Indians gave the French a tract of land lying at right angles to the course of the Wabash River at Vincennes. In 1763, the English took it away from the French and, in 1779, General George Rogers Clark took it from the English. The Vincennes Tract contains about 1,600,000 acres. The western part is in Illinois, but by far the larger part is in Indiana. Before the rectangular survey of it could be started, the outline of this tract had to be surveyed.

Thomas Freeman began the survey of the lines and corners of the Vincennes Tract in late summer of 1802. We do not know exactly how many men were with him, but he, in his field notes, called it a "little party". There were chainmen, axemen, a flagman, at least one cook, a packer, and teamsters.

There were also hunters with the party. They served, when necessary, as guards. The hunters would have been men well chosen for their work. The weapons they used were fairly soft metal, flint-lock, smooth bore Kentucky or Tennessee long rifles. One sport of the men who became hunters-for-hire on the frontier of that time, was contests to test their skill. They often perfected their craft to a point where they could hit either eye of a target as small as a squirrel. Since the meat supply as well, occasionally, as the safety of the party depended upon these men, their good marksmanship must have been a comfort.

The clothing worn by Freeman's men, and Buckingham's, two years later, was the same sort worn by other men on the post Revolutionary War frontier. Buckskin pants and shirts, boots, or moccasins and leggings, and raccoon

skin caps were the usual attire, but sometimes the flagman wore a red flannel shirt so that he might be seen more easily.

Matches were not invented until a quarter of a century after the survey of the Vincennes Tract, so flint and steel gave these men their fires. The fires provided heat for cooking, warmth on cold nights, and fuel to heat the metal to be ladled into the bullet-mold. The molding of bullets took a steady hand and a good eye. The amount of molten metal poured into the mold had to be exactly right or the result was a ball lacking the necessary perfection. The fire also provided light for copying out the field notes for the day.

The field notebooks of Freeman's time are usually about 3 by 6 inches. They are hand made from the old-fashioned paper called "foolscap". They have been stitched together with all the neatness you would imagine a man, by firelight, in the wilds of 1802 Indiana, could muster. Some of these old field notebooks are not stitched at all, but tied together with the thinnest strips of buckskin the men could cut.

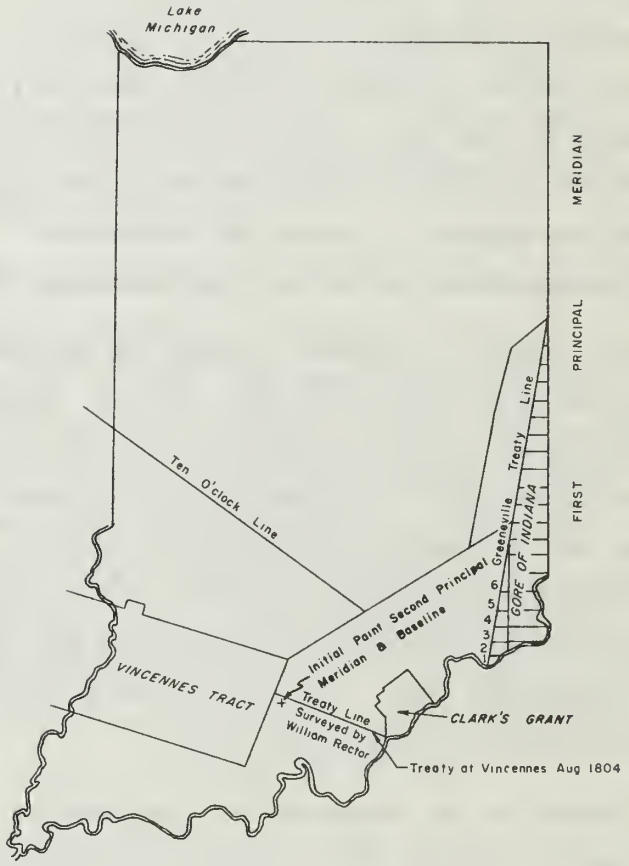
As he worked, his notebook, survey instructions, papers, an ink horn which could be opened at the small end, and which held ink brewed from bark by the men themselves, a sand horn with the opening at the larger end, to be used to dry the ink, and a quantity of wild goose feathers, to be sharpened into quill pens, were all carried by the surveyor in a buckskin pouch, suspended from his shoulder by a strap. He also carried his compass and his Jacob's staff.

Freeman's field notes reflect his care as a surveyor. He noted such things as Indian trails, very large springs, and other features. Freeman crossed the Yellow Banks Indian Trail in his survey and recorded it as 31 miles and 41 chains from the mouth of the White River. Nearby was a trapper's coal bank. Along his line, every now and then, his men split a sapling and pushed a limb through the trunk. These small trees which became large, enduring, oddly formed markers of a survey line, were called "peace trees."

If you draw a line on a map of Indiana from Point Coupee on the Wabash near Merom, Sullivan County, to Orleans, in Orange County, you will have approximately located the northerly boundary of the tract. It terminates at the point called "Freeman's Corner", which lies due east of Vincennes. If you draw the line from there to the southeast corner of Dubois County, you will have the approximate easterly boundary of the tract. Continue your line northwesterly from there to the mouth of the White River on the Wabash and you will have a fair picture of the part of the Vincennes Tract which lies in Indiana.

Apparently, when Freeman was nearly finished with the survey, the United States went back to before the original French title, and bought the land from the true original owners, the Indians. At the time of the treaty, June 7, 1803, Fort Wayne was a fort, and the document used there to describe the boundary was Freeman's survey. By this method, any doubt about the title was cleared away.

This was not the first time Thomas Freeman had



Outline Map of Indiana

been given a large and difficult job of surveying, nor was it the last. On October 27, 1795, a treaty defined the boundaries between the United States and the Spanish colonies of east and west Florida. The treaty was ratified March 3, 1796, and on May 24, 1796, Thomas Freeman was appointed surveyor for the United States for the purpose of running the international boundary line as called for in the treaty. (76)

The boundary line between Alabama and Tennessee is the 35th parallel of north latitude. Thomas Freeman made sextant observations for latitude in October 1807. He marked a point estimated as the 35th parallel, which was the northern boundary of Mississippi Territory in those days, and ran the line between the Elk River and the old Cherokee line. (37) This is the base line of the Huntsville Meridian. (39)

The part of the Alabama-Mississippi boundary from the mouth of Bear Creek, on the Tennessee River, to the northwest corner of what was then Washington County, Alabama, was surveyed in 1820, by John W. Exum, deputy surveyor under the direction of Thomas Freeman and John Coffee. (37)

Thomas Freeman was, clearly, a surveyor with wide experience long before he reached Indiana; a surveyor who had earned the trust of his country. That he continued to merit this respect is evidenced by the fact that from 1820 until his death in November 1821, (8) he was surveyor general of the public domain south of the State of Tennessee. (76) This office was a political one, but apparently experience sometimes counted.

Surveyors were sent to survey the Vincennes Tract into townships and ranges as soon as the Fort Wayne treaty was signed. The Second Principal Meridian passes very near "Freeman's Corner"; the base line runs east and west near the center of the tract. Contracts held by deputy surveyors called for the tract to be surveyed, in ranges 6 miles wide, north and south from Freeman line to Freeman line.

Within the Vincennes Tract were claims of the early French settlers. The United States honored these claims, and used the French

system in surveying them. They were usually 400 acres, lying in long, narrow lots at right angles to the rivers. The deputy surveyors who contracted to subdivide the Vincennes Tract closed upon these French boundaries.

Settlers started for Vincennes as soon as the treaty was in effect. Shortly after Buckingham set his first section corner a land office was established and the new land was opened for settlement. A great many people came from Kentucky. There was no rectangular system there, and many of Kentucky's pioneers lost their land simply because there had been no survey. Many titles were in doubt, including those of Thomas Lincoln and Daniel Boone. Hundreds of families came to Indiana by way of the old trails across Indian land. For the safety of the pioneers, the purchase of the land crossed by these trails was necessary.

The most notable early land route in the area entered Indiana at the Falls of the Ohio and followed a generally northwest course to Vincennes. It was called the "Buffalo Trace", for buffalo had made it and used it in unimaginable numbers. It was the most prominent of the several buffalo trails in the Indiana of 170 years ago, and it had been the most important of them as long as Indian memory before that. It was so significant that it was used as a means of determining a treaty line.

The Vincennes treaty was negotiated between General William Henry Harrison and the Indians in 1804. The treaty calls for all of this trace to be within the tract ceded to the United States, and for the boundary in that part to be a straight line, parallel to the "road" from the eastern boundary of the Vincennes Tract, granted to the Americans in the Fort Wayne treaty, to Clark's Grant. The line was to be no more than a half mile from the northernmost bend in the road.

The location of the 'straight line' was established by first surveying the Buffalo Trace by chain and compass. This was done, starting at Clark's Grant, by a surveyor named William Rector, who became surveyor general of Illinois, Missouri and Arkansas in 1814. Beginning on

July 11, 1805, trees were marked each mile along the trail with the distance from Clark's Grant.

The Vincennes treaty permitted settlers to enter Indiana across land owned by the United States. There was another result of clearing the title to these trails. Along some of them, enterprising pioneers built "houses of entertainment". It was ever thus; first the surveyor, and then the house of easy virtue!

The Vincennes treaty, and the land between the Ohio River and the Vincennes Tract covered by it, was probably the reason for the location of the second principal meridian.

The base line was surveyed in 1804 by Ebenezer Buckingham, Jr. The line began at a point on the Freeman line on the south side of the Vincennes Tract in Illinois, and ran east. He marked trees along his line, kept his notes, and set mile and half-mile posts. He did not set any corners, he just ran a line east for a distance of 67 1/2 miles.

The leaves had turned and there was a crispness to the air when he began at Thomas Freeman's southeast corner of the Vincennes Tract, and ran a line due north (now the Dubois-Orange County line), until he reached his base line. After intersecting the base line, at a point 3.60 chains east of his previously set 67 1/2 mile post, he went east on the base line, marking section corners, half section corners, and witness trees. He recorded them as he went along until he struck the Freeman line on the east end of the Vincennes Tract. Beyond that lay Indian land, so he returned to the intersection point on the present county line. He then went west along his base line, marking his corners and his witness trees, and probably resetting all his mile and half-mile posts 3.60 chains east, until he was in Illinois at the south Freeman line again.

When Buckingham started recording section corners, he recorded two beech trees as witness (bearing) trees. These are very special trees. Both are north of the base line; one is in Dubois County, one in Orange County.

They are the "witness" trees for the corner of four townships, and they are the first ones on record, in reference to a township corner, in all the surveys controlled by this base line and the Second Principal Meridian.

In September 1805, Ebenezer Buckingham, Jr., extended his base line east to a point 12 miles from the Dubois-Orange County line, and then ran the line north to the north line of the Vincennes treaty line. Not the Vincennes Tract line, the treaty line surveyed by William Rector. This Buckingham north-south line is the Second Principal Meridian. The location makes sense when you consider the facts as they existed at the time of the survey. It is there because it is 12 miles, or two ranges, east of the southeast corner of the Vincennes Tract. The northeast corner of the tract could not have been used as a basis for establishing a principal meridian at the time surveyor Buckingham contracted to do the work. One step north or south of that corner would have put him on Indian land!

Clashes with Indians were fairly common, but deputy surveyor John McDonald had more than the expected amount of interference from them when he undertook the survey of the northeast line, the "Ten O'Clock Line", of the Harrison Purchase. This line begins where Raccoon Creek enters the Wabash River and runs southeast to a point 30 miles from the northeast "Freeman Corner".

By 1809, the Indians had seen the result of several treaties. They were becoming aware of the loss of their land. They saw numbers of white men in the area south of them where once only Indians had been.

The United States Government surveyors, who came as soon as the treaties were signed, had begun to symbolize the wave of settlement that so swiftly followed them. By this time there were 250,000 trees with markings placed upon them by the surveyors. To the Indians, these were sure signs of an advancing alien culture, signs that their lands were slipping from them. By the time of the Harrison Purchase, the total amount of land ceded to the United States

under treaties signed by Harrison was close to 30 million acres.

There is a tale that the "Ten O'Clock Line" got its name from the Indians' suspicion of the surveyor's instruments. They wanted to mark the line by the shadow cast by the sun and an upright stake at 10 o'clock in the morning, because the surveyor could not manage the sun as he did the compass.

The Indian leader, Tecumseh, was not only suspicious of the instruments, he was dissatisfied with the sale of the land south of the "Ten O'Clock Line." He insisted that all the Indians held all the land in common, and that no tribe could sell any of the land because it belonged to all Indians. Harrison, of course, believed that Indians had a right to dispose of the land they occupied; that it was theirs by right of occupancy. In time the discontent Tecumseh and some of the warriors felt, over the treaty and the surveys, led to the battle of Tippecanoe, in 1811.

The conditions were still less than ideal, as noted by a surveyor, near the Indian town called Mississinewa, in November 1819, "...the Indians held another council on the 6th....which was much against me. My provisions were much wasted here, as we had to accompany their chiefs to the town, where the Indians made free with my bread. On the seventh they added another chief to my survey party, which I had to support with bread and meat."

It could have been worse. In fact, it rapidly became worse. Another entry in the field notes reads: "Here the Indians, in an imperious manner told me I was going wrong, and said I should go no farther that way, saying that I was going to go to their town and if I would not go 10 miles east of the town they would not let me go on. I saw by their looks and the way they behaved that I was unsafe, so I stopped. They would scarcely permit me to make a mark and appeared displeased. We left the line and started for Fort Recovery [Ohio] where we arrived on the 29th of the month [November 29, 1819]."

This entry is signed, "J. S. Allen, D. S.", and the next paragraph in the field notes begins: "March 18, 1820. Began where the Indians stopped me on the 25 of November, 1819."

Deputy surveyor Allen was certainly a perservering type. He began this particular survey on November 3, 1818, and completed it on March 20, 1820.

Northwestern Indiana presented its own forms of difficulty. Uriah Biggs, deputy surveyor, reported in January 1835 that Township 33 North, Range 6 West, had only a small part which could be cultivated. He found the Kankakee River a "sluggish stream, its banks very low and lined on each side with a heavy growth of timber, mostly ash...undergrown with swamp alder and wild rose, etc.,....covered with water during the season."

Surveyor Biggs described the soil in "this forest or swamp" as loose yellow sand and mentioned that he could approach the river only when the swamp was frozen!

Jeremiah Smith, working 12 miles east of Uriah Biggs, did not find things much better. He could not see his line at all. It was in the "expanded water of Yellow River". Of the next township north, Township 34, he had this to say: "There is but little room left for general remarks in this township. There is such an endless sameness of marsh,....that there is nothing upon which to digress from the monotony of lamentation."

Sometimes the deputy surveyors made rare finds. Edward W. Tupper and Augustus Stone, surveying in Township 1 North, Range 2 West, Second Principal Meridian, made note of a prominent salt spring. The surveyors estimated the quantity of water to be "sufficient to form a sheet of water two feet wide and one inch deep." About 4 chains southeast they found another salt spring with more than twice the amount of water afforded by the first spring. The two springs joined a fresh water spring located between them, and formed a creek from 12 to 20 feet wide. Salt springs could be seen boiling up through the stream from time to time. Several

springs, both salt and fresh, united to form a creek about 8 inches deep which seemed to stay very salty. The field notes indicate that the two surveyors found it necessary to reserve both section 3, Township 1 North, Range 2 West and section 34, Township 2 North, Range 2 West, due to the salt discovery. The surveyors did not give these springs the names they are now called. French Lick and West Baden were just "Salt Springs on Salt Creek," on the 1804 survey plat.

Two years after the discovery of these salt springs, Ziba Foote became one of the adventurous young Indiana surveyors. He was born in 1785, on one of our early Independence Days. He was a bright Connecticut yankee who graduated from Yale, with high honors, at the age of 20. He began surveying under the direction of William Rector, deputy surveyor to Surveyor General Mansfield, of Cincinnati, soon after his graduation.

One of his assignments was to conduct the survey of a pond in Township 3 South, Range 13 West, Second Principal Meridian. The pond was about 20 chains across and nearly a mile long. It was very shallow, and he started through it with his compass and his Jacob's staff fastened to his belt. A little way out, he found himself over his depth, and too weighted down to regain his footing. He drowned before anyone could reach him. It took 2 hours to recover the body. A bark coffin was prepared and he was buried on a knoll near the pond, which was named, "Foote's Grave Pond...." This accident happened on April 30, 1806, just over 2 months before his 21st birthday.

Surveyor David Sandford was born in Newtown, Connecticut, as was Ziba Foote. Sandford too went to Yale, graduating in 1804, 1 year before surveyor Foote. In 1805, he subdivided Range 5, of the Vincennes Tract. He obtained a contract to survey four townships on the Maumee River, but became ill, and died at Fort Wayne, October 11, 1805, at the age of about 25. George R. Wilson, who was once county surveyor of Dubois County, where young Sandford worked, resurveyed a number of his lines in Range 5, and bore witness to his efficiency.

David Sandford, in his field notes, mentioned a "remarkable ledge of rocks on the north bank" (of White River). He did exactly what you would expect a young man to do. His initials, D. S., are cut in the rock.

Also working in Dubois County, the surveyors of Township 3 South, Range 5 West, Second Principal Meridian, called a spade a spade.

The official entry describing the area of the half-section corner between sections 16 and 17 tells of, "A pigeon roost where the ground is covered with dung."

Some of the words and expressions used by the Government surveyors in the early 1800's sound a little strange to us now. They spoke of "middling soil", "sorry land", "gladly land", and "wavely land". They "rose" (went up) a hill, or found a "handsome spot". Strange sounding or not, they were there, and they called it as they saw it. (76)

THE REFINEMENT OF THE CADASTRAL SURVEY SYSTEM

"He turned about to the west side, and measured five hundred reeds with the measuring reed."

Ezekiel 42:19

Thomas Jefferson became President of the United States in 1801, and almost immediately learned that Spain had given Louisiana to France under a secret treaty. The idea of having Napoleon's colonial ambitions at work so near by was a bit upsetting. Jefferson, to get rid of the possibility of a French threat, asked Napoleon to consider selling his holdings in America. While he awaited an answer, he quietly planned to send an expedition across the continent. In preparation for the journey, Jefferson sent young Meriwether Lewis to Philadelphia where Robert Patterson and Andrew Ellicott taught him mathematics and surveying. (21)

In the meanwhile, in April of 1803, Napoleon agreed to sell Louisiana. The deal was completed and the United States more than doubled its territory. When Captain Meriwether Lewis and his red-haired co-leader, Lieutenant William Clark, started their historic expedition in late spring of 1804, they were able to go from the mouth of the Missouri River all the way to the Rocky Mountains on land owned

by the United States.

1803 also marked an advance in the development of the rectangular surveys. Jared Mansfield was named Surveyor General, and it was he who recognized the need for establishing base lines and principal meridians as a system of control. The Geographer's Line was a base line, and Ellicott's Line was a meridian, so the segments of his idea already existed; they just had not been brought together into a unified plan. When the previously surveyed line north from the mouth of the Great Miami was named the First Principal Meridian, and the astronomical position of the Indiana base line and the Second Principal Meridian was established under Mansfield's direction, the pieces became a system of rectangular coordinates. (32)

Josiah Meigs, who had worked under Hutchins on the survey of the Seven Ranges, (1) was appointed Surveyor General of all the public lands east of the Mississippi River in 1810. Two years later the General Land Office was established in Washington, D.C., as a bureau of the Treasury Department. Edward Tiffin, also a former surveyor, was named its first commissioner. In 1814, in a very neat exchange of jobs, Meigs became Commissioner of the General Land Office and Tiffin became Surveyor General of territories east of the Mississippi. Tiffin continued to hold this office for the next 15 years.

It was Edward Tiffin who solved the problem stemming from the paradoxical requirement, under the Ordinance of 1785, that the townships were to have sides running in the cardinal directions, and that they were to be rectangular. There would have been no problem if this planet had been flat, but surveyors knew from the outset that fulfilling that requirement would be made impossible by the fact that our planet is spheroidal. There had been discussions in Congress about it, but nothing was done about the convergence of meridians until Tiffin devised a plan of correction lines and offered it as a solution.

When Mansfield was Surveyor General the Indians still held central and northern Indiana. As a

result, the surveys completed under his leadership did not extend far from the base line. When the surveys, under Tiffin, began to reach farther north, it was obvious that additional controlling lines were necessary. To add this control he formed the plan which, as it was used and refined, became one of the most important parts of the public land survey system.

In 1815, in the interest of uniformity of field procedure, Tiffin issued a set of instructions for the guidance of the deputy surveyors. Tiffin's instructions were partly based on unsigned instructions issued earlier by Mansfield. (68) They were the first signed and dated general instructions ever issued, and were used as a model for several circulars sent out in the following years.

The reorganization of the General Land Office in 1836 made cadastral surveying its responsibility. (1) With the expansion of the surveys and the greater number of surveyors general, some sort of official instruction became necessary. In the 1851 "Instructions to the Surveyor General of Oregon; Being a Manual of Field Operations," it was stated that standard parallels were to be run at distances of four townships north of the Columbia River, and five townships south of the Columbia. These distances were repeated in 1855, when the General Land Office published its first manual of instructions.

The Manual of 1881 changed the Manual of 1855, and initiated the present method of dividing survey districts into "twenty-four mile tracts." Prior to the Oregon Manual of 1851, various instructions stated that correction lines were to be evenly spaced, but the intervals varied. Now, if additional standard lines from which to begin new surveys, or upon which to close the extension of old surveys, are required, an intermediate correction line is established. These intermediate lines may be given names of local significance such as, "Fifth Auxiliary Standard Parallel North," or "Cedar Creek Correction Line." They are run exactly like a regular standard parallel.

While Tiffin was still Surveyor General, in 1818, a boundary settlement with Great Britain gave a rich portion of the Red River Valley

south of the 49th parallel to the United States. (16) Early settlers along the Red River north of the parallel surveyed land using the Indian measurement of 2 miles for the depth of a lot. They had found that the distance bounded by a horizontal line of sight made under the belly of a horse measured somewhere near 2 miles, if the land was level. The build of the horse must also have had a good bit to do with that measurement. (35)

The following year, 1819, Spain ceded both East and West Florida to the United States. Under the terms of the treaty conflicting claims were settled, and the boundary between the two countries was defined as the line made by following the west bank of the Sabine River to the 32nd parallel; then north to the Red River, and along its course to the degree of longitude 100 west of London. (The treaty also specifies this position as 23° west of Washington, so there was some uncertainty as to this boundary location. The position was recognized as the one-hundredth degree west of Greenwich in Acts of September 9, 1850 and June 5, 1858.) The boundary then ran due north to the Arkansas River, and along its southern bank to the 42nd parallel; then along that parallel to the Pacific. (37)

At about the time of these boundary settlements, the attitude of Congress toward settlers on the public land was undergoing a subtle change. The importance of money from the sale of land was giving way to an interest in encouraging new settlements. (2)

In the early 1800's a migration of optimistic, restless people began. They moved westward with everything they owned, which usually was not much. The magnet which drew them was land. They searched for good farms, and for the adventure and success which might be theirs on the American frontier.

The laws covering the sale of the public lands called for survey prior to settlement, but surveyor's lines sometimes ran through fields already being tilled. At first the people who took up land ahead of the surveys were looked upon as trespassers. Unauthorized settlers on

the land of the public domain stopped being a big problem when Congress started to see them, not as squatters, but as brave pioneers.

As a result of this change in attitude, the survey and sale of half-quarter sections was allowed, for the first time, under the Act of April 24, 1820. This permitted people of limited means to buy land at the minimum cash price of $1.25 per acre.

By the time this Act was passed by Congress, about half of the public domain land in Alabama, Indiana, and Ohio was surveyed. The surveys had started in Arkansas, Louisiana, and Mississippi; and about a quarter of Missouri and Illinois had been surveyed. (32)

Ten years later the Act of May 29, 1830, was passed making it illegal to obstruct the survey of the public lands, and calling for the protection of the surveyors in the discharge of their official duties.

The same year this law was passed, 1830, Abraham Lincoln left Indiana on his way to Illinois. He followed the heavily traveled "Buffalo Trace," and crossed White River on a ferry owned by Mr. N. Harlan. The reason authorities feel reasonably sure of the existence of the ferry at that time, is that both banks of the river were meandered during the surveys of 1805 and 1807; and the field notes show the land claimed by the enterprising pioneer before the area was subdivided. It was surveyed and recorded as "Claim Number 3." (76)

Lincoln served as captain in the Illinois Militia during the Black Hawk Indian Wars, (1) and came home to New Salem, and to a period of hard times, in 1832. He was friendly and well liked, but there just were not many jobs available. He accepted the position of postmaster, even though the pay was small. He made more friends, but he had resorted to doing odd jobs to meet his expenses by the time he became acquainted with John Calhoun, the surveyor of Sangamon County. (99)

Sangamon County was a large one in those years, and settlers created a need for surveys. Calhoun offered Lincoln a job, even though at

that time Lincoln had no experience as a surveyor. He took the job, and began studying with single-minded purpose. Perhaps he recalled that his father had lost their home in Kentucky because of uncertain land lines, and realized the importance of this work.

Lincoln was ready to start surveying on his own by the end of 1833. The secondhand surveyor's compass he bought was one made by Rittenhouse and Company. It had two opposed leveling vials and an improved vernier. The Gunter's chain he used is only 33 feet long, perhaps because he was working in an area of heavy undergrowth.

The first record of a survey by Abraham Lincoln is dated January 6, 1834, just over a month before his 25th birthday. The work was done for Reason Shipley, who owned eight 80-acre parcels in Township 19 North, Range 7 West, Third Principal Meridian. This area is now in Menard County, but in 1834 it was in Sangamon County.

In the latter part of 1822, deputy surveyors D. Miller and A. Monday surveyed the subdivisional lines of the township, placing stakes set in mounds at the section and quarter section corners. Abe Lincoln probably used their field notes extensively in locating the original points set by the two Government surveyors. Later, Lincoln surveyed another section for Mr. Shipley, in all about 1,280 acres.

The majority of Lincoln's surveys were in the same general area. For his work he was paid the rate set by law; for example, he would have received $2 for each half-quarter section he established. The records indicate that he did about 30 surveys, the last one shortly after he had been admitted to the bar, in 1836.

Some of his work as a lawyer came to him as a direct result of his experience in surveying. On January 6, 1859, a group of Illinois surveyors hired him to formulate a legal opinion as to the correct method of dividing a section into quarters.

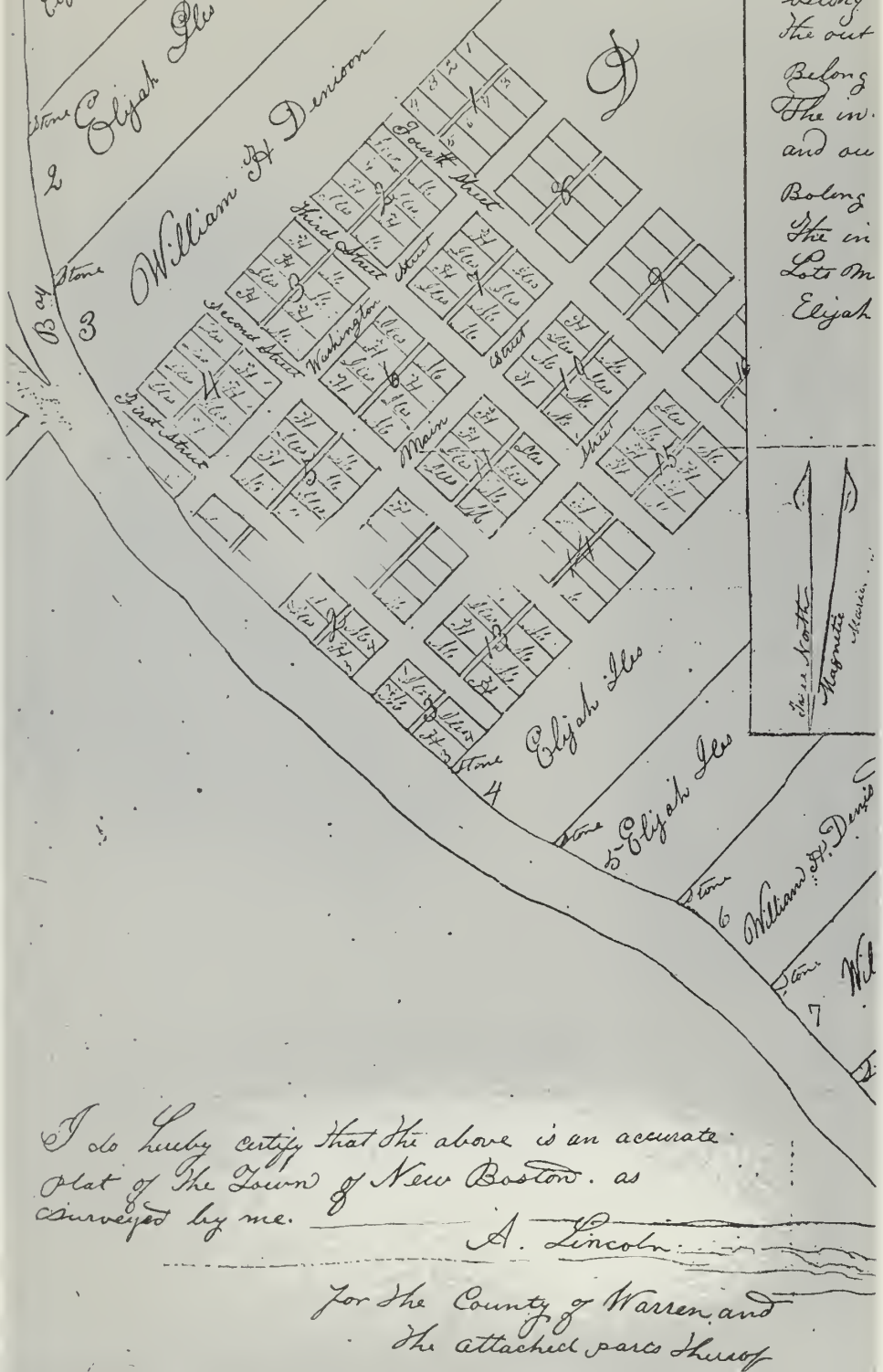
His position as a surveyor helped him to solve his financial problems, and make a modest

living. He proved himself to be an energetic, capable man by working hard and becoming a good surveyor. For more than 2 years, while he was in his 20's, Lincoln practiced not only the mathematics of surveying, but the investigation and observation, the skillfull examination of evidence, and the knowledge of land law required by this profession.

Some of these things may have influenced the people who started him on his political career by electing him to the Illinois General Assembly in 1836. (99)

Josiah Meigs, appointed Surveyor General of all public lands east of the Mississippi River in 1810, exchanged positions with Edward Tiffin in 1814.

Edward Tiffin was the first Commissioner of the General Land Office. In 1814 he became the Surveyor General of the public lands east of the Mississippi River and Josiah Meigs became the second Commissioner of the GLO.



A copy of part of the plat for the town of New Boston. It is situated on fractional section 31 and the southwest quarter of section 32 in Township 14 North, Range 5 West, in Illinois. The original plat is in the Mercer County Records Office, Aledo, Illinois. (59)

Abraham Lincoln, surveyor.

The 11th Section of the act of Congress, approved Feb. 11, 1805, prescribing rules for the subdivision of Sections of land within the United States system of Surveys, standing unrepealed, in my opinion, is binding on the respective purchasers of different parts of the same Section, and prescribes the true rule for Surveyors in establishing lines between them— That law, being in force at the time each became a purchaser, becomes a condition of the purchase—

And, by that law, I think the true rule for dividing into quarters, any interior Section, or Section which is not fractional, is to run straight lines through the Section from the opposite quarter section corners, joining the points which such straight lines, cross, or intersect each other, at the middle, or center of the Section—

Stand, perhaps quite, all the original Surveys as to actual extent, quantity, &c. in case of the Sections, greatly so— In each of the latter, it is obvious that a new equitable mode of division than the above, might be adopted; but as error is infinitely various, perhaps no better single rule can be prescribed.

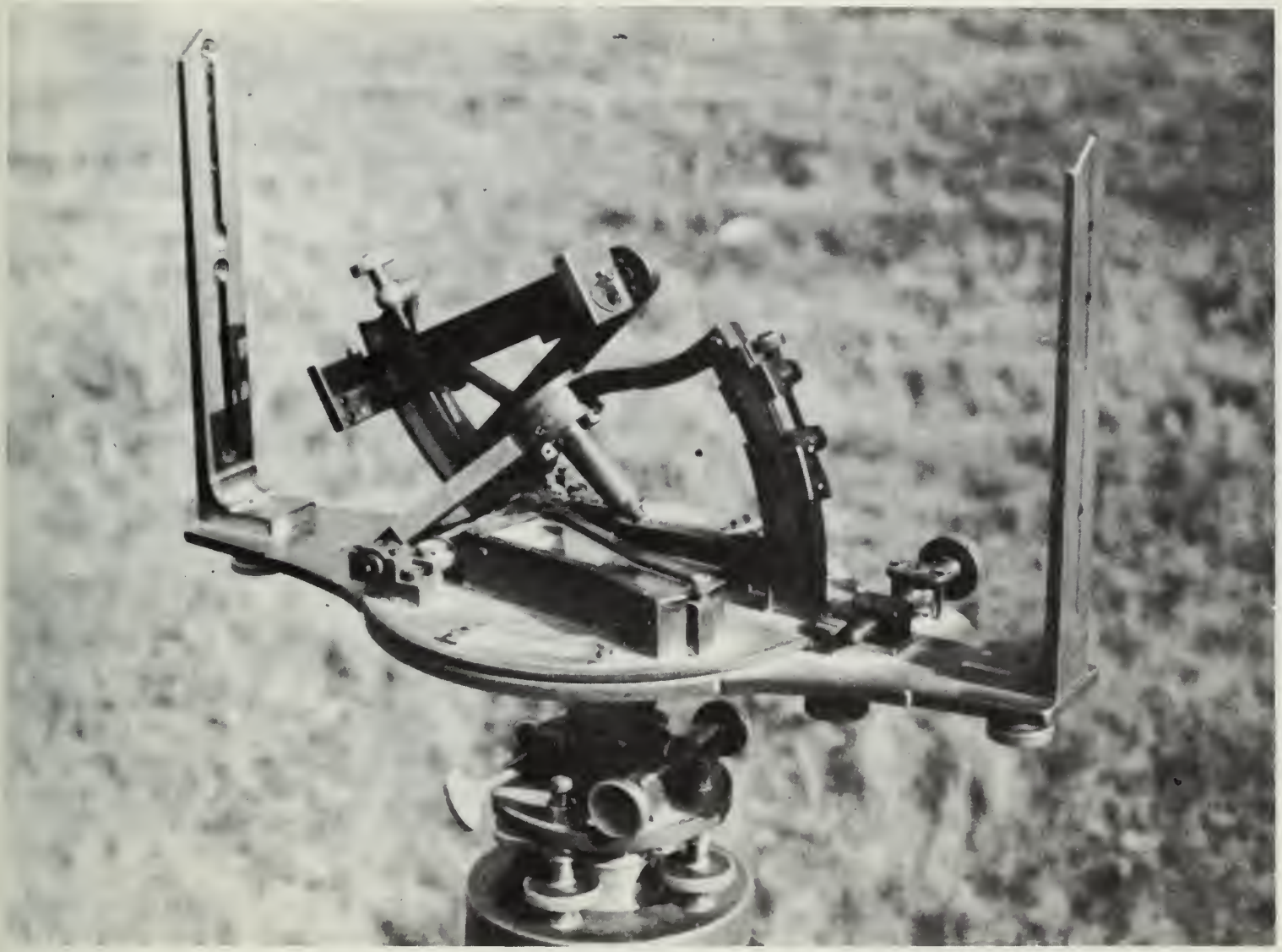
At all events, I think the above has been prescribed by the competent authority—

Springfield, Jany. 1. 1859. A. Lincoln

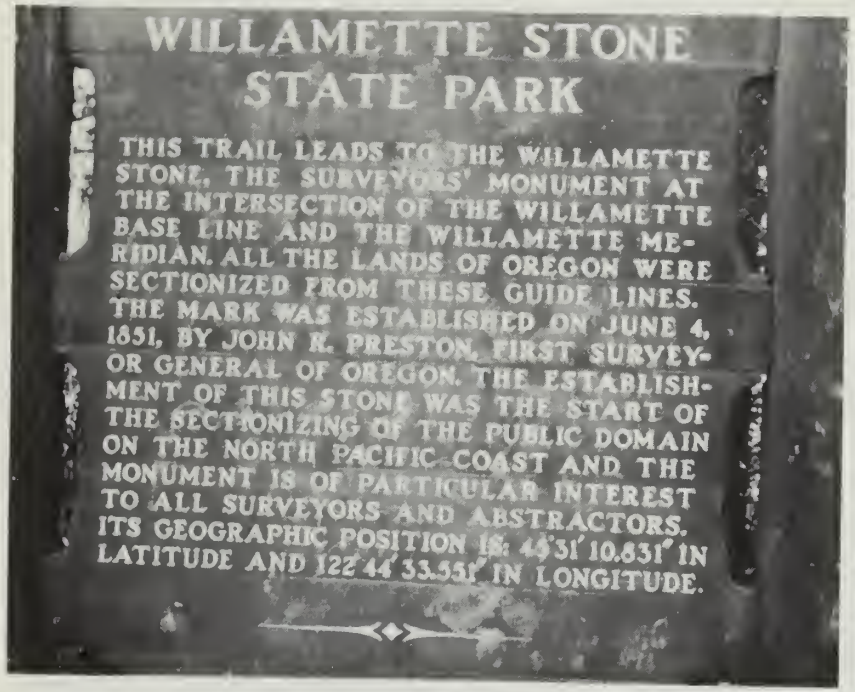
A facsimile of the legal opinion formulated by Abraham Lincoln concerning subdivision of sections. (59)

Portion of plat approved 1849.
Survey by William A. and Austin Burt and William Ives. (65)

1950 aerial photograph of same area as shown on preceding page. (65)



Aluminum Young and Son solar compass number 8510. Records show that it was in Colorado in 1911 and 1912. It came to the Olympia, Washington Land Office in 1913, and was used by Andrew Nelson that year. Herbert Raymond used it in 1914, and George R. Campbell used it from 1915 through 1918. The instrument is still in good adjustment and it is still in use. (60)


WILLAMETTE STONE
STATE PARK
THIS TRAIL LEADS TO THE WILLAMETTE STONE, THE SURVEYORS' MONUMENT AT THE INTERSECTION OF THE WILLAMETTE BASE LINE AND THE WILLAMETTE MERIDIAN. ALL THE LANDS OF OREGON WERE SECTIONIZED FROM THESE GUIDE LINES. THE MARK WAS ESTABLISHED ON JUNE 4, 1851, BY JOHN R. PRESTON, FIRST SURVEYOR GENERAL OF OREGON. THE ESTABLISHMENT OF THIS STONE WAS THE START OF THE SECTIONIZING OF THE PUBLIC DOMAIN ON THE NORTH PACIFIC COAST AND THE MONUMENT IS OF PARTICULAR INTEREST TO ALL SURVEYORS AND ABSTRACTORS. ITS GEOGRAPHIC POSITION IS: 45°31' 10.831" IN LATITUDE AND 122°44' 33.551" IN LONGITUDE.

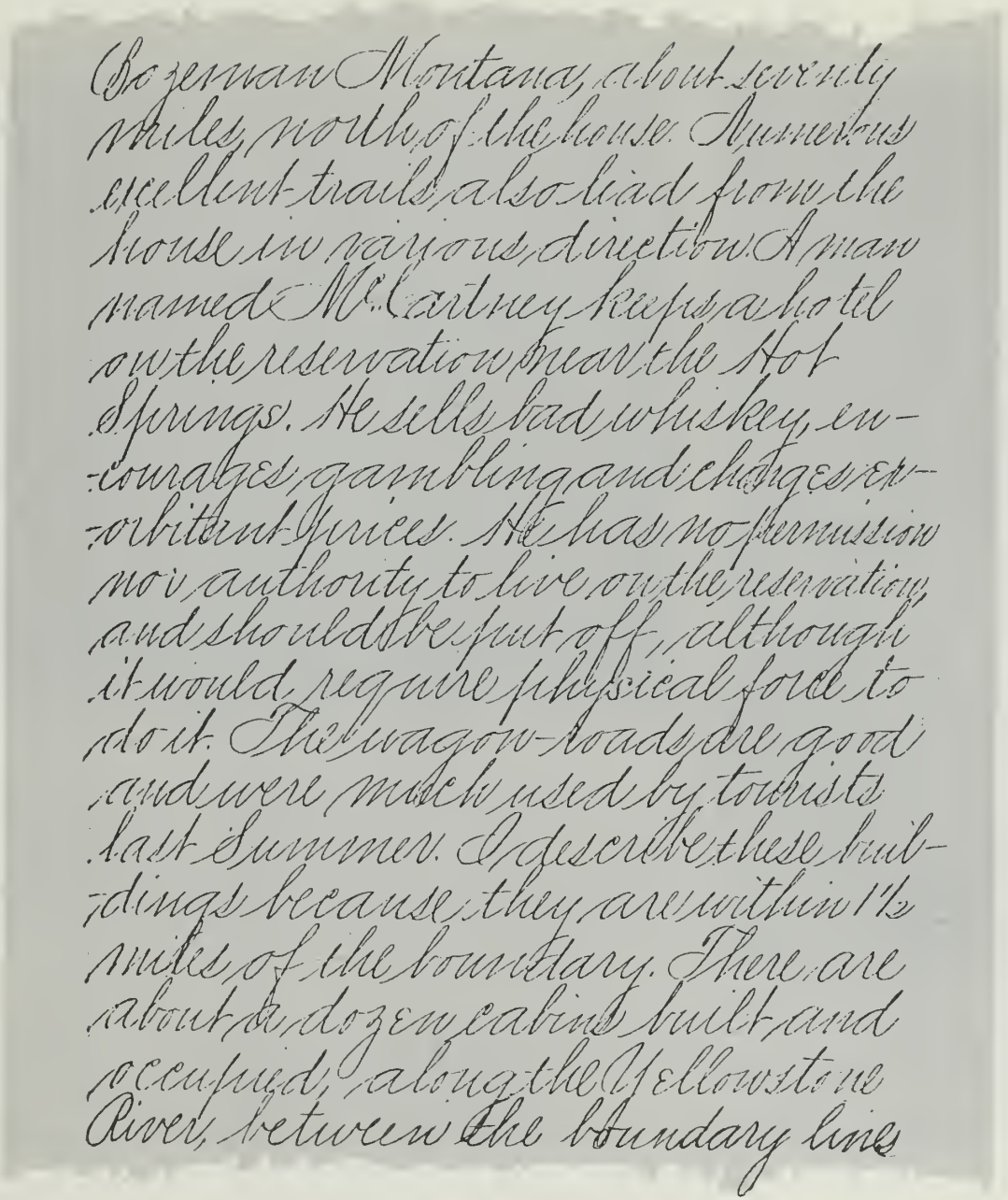
This sign, which is beside Skyline Boulevard in Portland, Oregon, marks the trail to Willamette Stone State Park. It is accurate in all but one detail: the first surveyor general of Oregon Territory was John B. Preston, not John R. (60)

The solar compass pictured above is the type of instrument used in the original surveys of the Willamette Meridian and Base Line. The picture was taken in Willamette Stone State Park. (60)

with the Principal Meridian
(The point of intersection is on
an isolated Hill on the west
bank of Rio Grande about
120 Chains N W of the Mexican
town of La Joyita) by John
W. Garretson Deputy Surveyor
under his Contract of 9th of
March 1855
I run the Principal Meridian
South 60 miles. in April last
I suspended operations on account
of there being no water at that
time on the Jornado Del Muerto
thence after running the
Principal Meridian 48 miles
north I received the Report
of the Commissioner of
the General Land office in
which the Standard Chain is
described the Standard measure
being the Space between the rivets
within the handles. The re-
-markably foolish penchant for
novelty has cost me the running
108 miles twice
The initial point is fully de-
Scribed in notes of Principal
Meridian North of Base line

Chain Compared and adjusted
to the Standard measure

A small portion of deputy surveyor John W. Garretson's field notes of his 1855 survey of the New Mexico Principal Meridian. (Courtesy Duane Olsen)



Bozeman Montana, about seventy
miles north of the house. Numerous
excellent trails also lead from the
house in various direction. A man
named McCartney keeps a hotel
on the reservation near the Hot
Springs. He sells bad whiskey, en-
-courages gambling and charges ex-
-orbitant prices. He has no permission
nor authority to live on the reservation,
and should be put off, although
it would require physical force to
do it. The wagon-roads are good
and were much used by tourists
last Summer. I describe these buil-
-dings because they are within 1½
miles of the boundary. There are
about a dozen cabins built and
occupied along the Yellowstone
River, between the boundary lines

The field notes of the 1879 survey of the Wyoming-Montana boundary include this early case of trespass on the public lands.

After reading it, one might wonder if the surveyor would have objected so strongly had the hotel keeper's whiskey been good and his prices lower. (63)

Montana, U.S. Surveyor-General's office clerks about 1890. (63)

EARLY SURVEYS WITH THE SOLAR COMPASS

"He measured the east side with the measuring reed, five hundred reeds, with the measuring reed round about."

Ezekiel 42:16

During the time Andrew Ellicott was surveying the site for the City of Washington, a boy named William Austin Burt was born at Taunton, Massachusetts. He grew up in New York state, where he spent a lot of time studying such things as geometry, navigation and surveying. His formal schooling was limited to only a few weeks, but these subjects, along with mechanics, fascinated him. (72)

Burt became a United States deputy surveyor in late 1833, but before that he had been a district and county surveyor in Michigan, and had held a wide variety of jobs. He was a soldier in the War of 1812, a businessman, a builder of mills, a justice of the peace, school inspector, postmaster and member of the Michigan territorial legislature. He was also an associate district judge, and judge is the title by which he was known during his years as a deputy surveyor. (32)

While he was surveying in northern Michigan, he found himself having a great deal of difficulty due to the deviation of the needle of the magnetic compass. He figured out what was

causing its erratic behavior, and is thereby credited with the discovery of iron ore in the region. (72) Unfortunately, knowing what caused the problem did not solve it. Burt worried about that wandering needle until he came up with an idea that evolved into the solar compass, which he patented in 1836.

William A. Burt taught surveying to all five of his sons; John, Austin, Alvin, Wells, and William. (31) The records of the Bureau of Land Management show that the Burt clan surveyed enormous areas of land in the upper peninsula of Michigan, and in Wisconsin and Iowa. These surveys cover almost a quarter of a century, from the early 1830's to the middle of the 1850's. (82)

On these surveys they probably used an outfit something like the one Judge Burt suggested in his book, "A Key to the Solar Compass, and Surveyor's Companion." In it was a list of tents and other camp equipment, clothing, bedding, and provisions; pack animals and gear, and surveying instruments which he had found were needed by a 6-man survey party for a 4 month survey of the public lands.

This book was really intended to be just what part of the title said--a surveyor's companion. It even gave the following recipe for making bread: "Spread the cloth [cotton drilling about 1 yard square] on a blanket, folded and laid on the ground; pour enough flour upon it for a mixing, and make a hollow in it; then pour some lard from the can, and add some saleratus [baking soda] and salt dissolved in warm water, stirring the flour with a spoon to a proper consistency for kneading with the hand, taking care not to reach the bottom of the flour so as to wet the cloth. Bake the loaves in the frying pans before the fire, and when done, fold the cloth, and lay it aside for future use."

Judge Burt recommended lard and saleratus be kept in two half-round cans made to fit inside the heavy tin covered camp pails or kettles. These kettles had oblong bottoms, with upright sides. The largest of the four pails usually used was about 9 inches deep, so that it would hold 12 or more quarts. The other three were

of graduated sizes so that they could fit into one another and into the largest kettle. Burt suggested that 14 tin basins about 6 inches or so in diameter, and 1 1/2 inches in depth, be included. These basins were used as "plates, cups, soup or meat dishes, & c."

Experience had apparently taught Burt that things did not always go well, so he listed as requirements such things as "4 papers of 3 oz. tacks for nailing boots," and "....needles, awls, thread, twine, small cord, & c." He also made a point of mentioning that the 2 dozen boxes of matches were to be of the "best kind"; and that the camp kettles should be riveted "....where they would be likely to separate when exposed to the fire." (7)

The publication of this book in the 1850's added authorship to William A. Burt's credits.

Burt was not only a gifted man; he was an honest one. The same year the "Home" or Interior Department was created, 1849, he was named examiner for some of the surveys in Michigan. Two of his sons had surveyed in the area, and he knew all of the surveyors. He found that one friend's survey, for which he was the security, was fraudulent. He reported his findings. Later, he made good on the contract by surveying it himself. (72)

In Colorado, in 1880, another United States surveyor, Benjamin H. Smith, developed the telescopic solar attachment for an engineer's transit. It was the prototype of the modern solar attachment. The instrument now in use owes much to the dedicated efforts of Arthur D. Kidder, who was the associate supervisor of surveys in the General Land Office. He, in cooperation with respected instrument makers, conducted development studies which resulted in improvements in the solar transit.

The Emphemeris for use of the United States surveyors in the operation of the solar transit was devised by Arthur D. Kidder. (82) It has been published annually since 1910.

William A. Burt's solar compass came into wide use shortly after he invented it. It was officially recommended as early as 1850, (14)

but it was not required by regulations until 1890. The Manual of Surveying Instructions issued that year prohibited the use of the magnetic needle except in subdividing and meandering, and then only if the locality was known to be free from local magnetic attraction. The Manual issued 4 years later required that all surveys of the public lands of the United States, embracing all classes of lines, be made with reference to the true meridian, independently of the magnetic needle. The 1902 Manual was even stronger in its words against the use of the compass. In 1919 a part of the Manual issued in 1930 was published, and unqualifiedly prohibited the use of the needle compass as a means of determining the direction of lines of the public land surveys. (50)

In the late summer of the year Judge Burt examined surveys in Michigan, Colonel John Evans received a contract to subdivide 10 townships in Iowa. He sold a half interest in the contract to Ira Cook, and they made plans to begin the survey. (73)

Even though there were thousands of settlers in Iowa several years before that, (2) their contract lay a long way beyond the populated area. They knew the survey would take quite awhile, so they planned accordingly.

In relating his experiences nearly 50 years later, Ira Cook described the outfit they assembled as being a tent, "....the simplest necessities of food and clothing. A barrel or two of salt pork, flour in barrels, navy beans, with sugar, coffee, salt and pepper,.... For bedding we had rubber blankets, buffalo robes, and heavy woolen blankets. With these we could keep both warm and dry." (73)

Their survey party consisted of 11 men, because they used two instruments. Besides the instrument men there were four chainmen, two axemen or mound builders, two teamsters who acted also as flagmen, and a cook.

It took them 2 weeks to reach the land they were to survey. The "numerous branches of the Grand and Missouri Platte" slowed them up considerably. Once in awhile they found two

large cottonwood trees on opposite banks of the streams. They cut them down in such a way that they met and overlapped to form a foot bridge. They then unloaded the wagon, carried everything across, swam the horses over, fastened the axles and wheels of the wagon to the box so they would float, and floated the wagon to the other side. When the wagon reached the other side, they hitched the horses to the wagon tongue. As the men lifted and the horses pulled, the wagon was landed on the river bank. Then they fixed the axles and wheels for land travel, loaded the wagon, breathed a sigh of relief, and started out again.

If it was late by the time they completed one of these crossings, they ate cold food, drank hot coffee, grabbed their blankets, and hunted a soft place on the ground to spend the night.

When they reached their contract area, they started work each morning as soon as they could see. They often worked until dark and then hiked back to camp.

Ira Cook and his crew finished the contract in January 1850. Since there were people living along the Missouri, they went south so that they might sooner reach some settlement. By the time they reached the Platte River, they were pretty used to cold weather, and were not too shocked when they found the ground frozen so hard they could not drive the stakes to put up their tent. There was no timber, only a few scattered trees they used for firewood. They built a roaring fire, and had their supper. As they pulled their bed rolls close to the fire, using the wagon for a windbreak, they knew it was cold. They did not know just how cold it really was until they reached a settlement in Gentry County, Missouri the next day. They were told then that the temperature had been 31 degrees below zero!

For several months in 1851, Ira Cook and his party surveyed in the swamps and heavy timber between the Wisconsin and Wolf Rivers, on the divide between the Mississippi River and the Great Lakes. Since he spoke of their inability to see the sun in some places, they were

probably using a solar compass. The survey soon took them into places that were impassable for the wagon. They packed the camp equipment on the horses, and went that way as far as they could. When the horses could not go any farther, the men carried what they could on their backs. The farther they went, the lighter their load grew, as their rations of food shrank. Finally, for a day and a half, they subsisted on salt pork and coffee.

The next year, Ira Cook made up for the hardship he had so recently endured. He worked for 2 months among hills, canyons, and swiftly flowing streams near the Iowa-Minnesota boundary. It was spring, the country was beautiful, and those streams were full of speckled trout!

From September 1852 until just after New Year's, 1853, Cook's 11-man survey party subdivided 10 townships in a part of Iowa which lay well beyond the limits of white settlement. During those 4 months they had not one word from the world outside their camp. They did not even know who the President of the United States was. There had been an election in November, but they had no way to know the name of the winning candidate.

They left camp, on their way back to civilization, with 3 days provisions. It should have been enough so they could reach the squatter's cabin where they had cached some of their food without hardship, but a snowstorm changed all that. By 9 o'clock in the morning on the 2nd day of their journey, it was snowing so hard they could not see their way. They pulled down into some timber and made camp. It snowed all day and night. Ira Cook arranged with the camp cook to ration what was left of the food. Two days later they dug themselves out of the snow and crossed the river on the ice. The men formed lines and broke a trail for the horses and wagon through the knee-deep snow. It was slow, exhausting travel, and the days were short. On the morning of the 7th day they left the wagon, in order to save the horses. The sun came out and warmed their spirits as it melted some of the snow.

At 4 o'clock in the morning on the 8th day,

"...the cook made a pot of strong coffee and distributed the very last of our food, which consisted of one small biscuit (then five days old) and one very small spoonful of cold boiled beans to each, and long before daylight we were tramping over the prairie by moonlight, breaking the frozen crust of the snow..."

Later that morning they saw a cabin off in the distance. Even though they reached safety with no noticeable effects, other than improved appetites, Ira Cook made no more contracts as a government surveyor. (73) He must have decided to quit while he was winning.

Not all of the men on early day Iowa surveys ended their careers on such a happy note. The rather abrupt termination of employment of one of the men on Alex Anderson's survey crew was recorded in the field notes. The survey line was near Sioux City, and the 1852 field notes read: "Ivy Johnson, one of my men, was accidentally shot yesterday and died almost instantly.

"North between Sections 21 and 22, variation 11° 30' East.

30.00 leave bottom N.W.

40.00 Set 1/4 section post in a mound of earth and sod pit East and West 8 links.

Ivy Johnson's grave from this 1/4 post bears S. 71-1/2° West offset North 14-1/2 West East [sic] 5.00 chains bears S. 67-1/2 West.

80.00 Set post for corner to sections, 15, 16, 21, and 22 in a mound of earth and sod pit South 8 links." (14)

While some field notes reveal tragedy, others tell quite a different tale.

As Daniel G. Major's survey party worked westward on the survey of the Oregon-California boundary in 1869, Mr. Major used a great many descriptive words about the brush they encountered. In his field notes some of it is called "thick", "dense", "tangled", or "difficult". Some of it he termed "heavy", "matted", "troublesome", or "impassable". When they had surveyed about 168 miles they descended the

"fearfully brushy" side of a mountain and crossed Steamboat Branch of Applegate Creek. Beside this stream, the survey party rested. They soon noticed "excellent gold indications." The men forgot about brush, and successfully panned gold for an hour or so. When they went on their way, their hearts were lighter and their pockets were heavy with gold.

THE FAR WEST

"And as for the western border, ye shall even have the great sea for a border: this shall be your west border."

Numbers 34:6

As early as 10 years before the Revolutionary War, Major Robert Rogers, commander of an upper Mississippi Valley English post, requested permission from King George III to send an exploration party to the Pacific by way of a river "called by the Indians Ouragon." (3)

No such party was ever sent; and the river called Ouragon, Origan, Oregan, or Oregon, remained a legend, the mysterious "River of the West", until an American, Captain Robert Gray, sailed into its mouth on May 11, 1792. The journal kept by Captain Gray has been lost, but John Boit, his fifth officer, also kept one. It tells of the discovery of the river, and that it was named "Columbia" in honor of Gray's ship.

When Lewis and Clark reached the mouth of the Columbia River on a bleak November day in 1805, they proved that travel overland from the east was possible. They spent the winter about half a dozen miles southwest of the point of land where John Jacob Astor's party set up a fur trading post in 1811.

As a result of the War of 1812, the British took command of Astoria and held it until 1818, when it was returned to the United States. It remained, however, under the domination of the British Hudson's Bay Company, whose headquarters was moved up river to Fort Vancouver (Washington) in 1824. (3)

During this time, Mexico declared its independence from Spain. In the following few years, Stephen F. Austin, among others, began to build an empire by starting a colony beside the Colorado River in Texas.

In 1831 the first permanent Indian reservation, called Indian Territory, was established on public lands west of Iowa, Missouri, and Arkansas; and the survey of Louisiana was started. (1) It was many years before the Indians left much of the vast area of the Louisiana Purchase and the Floridas, years before these lands were surveyed and settled, yet Americans pushed on, searching always for new land. Millions of rich areas in Minnesota, Iowa, and the other prairie states remained unsettled; and in the South, the most productive cotton land in the world went begging while restless Americans followed the trail shaped by the mountain men and used by the missionaries, the trail to Oregon.

Men who were not American also dreamed of empires. In 1834 a man named Johann August Sutter left his native Switzerland, and incidentally, his wife and children, and his unpaid debts. He sailed aboard the square-rigged "Esperence" when it left Havre, France on its maiden voyage to New York. (9) Two years later a small band of Texans, including Davy Crockett and Jim Bowie, fought to the last man at the siege of the Alamo. Six weeks after that, Sam Houston defeated Santa Anna and the Republic of Texas came into being. In 1838, about the time the surveys in Iowa and Wisconsin were started, Sutter followed the Oregon Trail to Fort Vancouver, on the Columbia River. From there he sailed to Honolulu and eventually, to California.

In Honolulu, Sutter arranged for a group of Hawaiian workmen to be sent to meet him at San Francisco Bay. These "Kanakas" were part of

his plan to build a grand and powerful place for himself. The Mexican Governor, Alvarado, made Sutter a Mexican citizen, and gave him eleven square leagues of land wherever he chose to establish his colony. He chose the Sacramento Valley, near the mouth of the American River.

Soon houses, a tannery, a gristmill, and a winery were built. His men drained and cultivated land. Crops and vines were planted. He acquired cattle and horses. Before long, Governor Alvarado's successor, Michel Torena, granted Sutter enough land to increase his holdings to thirty-three square leagues. Within a few short years he had built a large fort and purchased the Russian claim to land in northern California. (18)

In 1842 the East Florida Donation Act was passed. It granted one quarter section of public land in eastern Florida to any man who settled in the part of the state occupied by hostile Indians. (1) That same year, Dr. John McLoughlin, Chief Factor of the Columbia River Department of the Hudson's Bay Company, gave the name "Oregon City" to the small village at "the falls of the Wilhamet." He had the town platted by an American who had just arrived with the first large group of settlers. He chose Sidney Walter Moss, a stone cutter, (22) to do the survey for a very simple reason. Moss owned a pocket compass. (3)

The settlers who reached the Willamette Valley the following year, 1843, made up the body known as the Great Emigration. It was so called not only because of its size, which was without precedent, but also because of the number of its members who were unusually able, and who became leaders among the Americans in the Oregon country. (18)

The wagons of the Great Emigration assembled near Independence, Missouri in early May, and the wagon train set out for Oregon toward the end of that month. Peter H. Burnett, who became the first governor of California, was chosen Captain, and James W. Nesmith, later a senator from Oregon, was the orderly sergeant.

Soon the company divided into two factions, those who had cattle and those who did not. The ones without cattle did not want to move slowly, and stand guard over the livestock. Peter Burnett was unable to solve the problem, and resigned the post of captain. Those pioneers who had no cattle chose William Martin as their captain, and those with livestock elected General M. M. McCarver. He declined the honor, and Jesse Applegate was selected instead.

The group unhampered by livestock moved ahead. The other group formed itself into what has become known as the cow column, and fell in behind. (18)

Jesse Applegate, the leader of the cow column, was born in Kentucky in July 1811. He and his older brothers Charles and Lindsay moved, with their parents Daniel and Rachel, to a farm in the Osage Valley, not far from St. Louis, Missouri in 1820. (11)

Charles Applegate married Melinda Miller and they had six children. Lindsay also married a Miller girl, Elizabeth, and they too had six children, all boys. Jesse attended Rock Creek Seminary in Shiloh, Illinois, and taught school for awhile. He worked as a clerk in the office of the surveyor general of Missouri at St. Louis, and later became a deputy surveyor there. He married a girl named Cynthia Parker, and they settled down on a nearby Osage Valley farm. Jesse did not spend all his time surveying. He and Cynthia had 13 children.

All three of the Applegate brothers and their families were part of the Great Emigration as it crossed the plains. All three families settled first in an area later known as Polk County. They moved in 1849, to the southwestern Oregon area they called Yoncalla. (11) All three of the Applegate men were prominent early Oregonians; but it was Jesse who became a noted pioneer politician, in spite of the fact that all his life he disliked mirrors because he thought himself so homely. He was over 6 feet tall, and people could identify him from a distance by his loose-limbed easy stride. (23)

In 1844, Jesse Applegate did what was probably the first of his many survey jobs in Oregon. He was given the task of replatting Oregon City, and making it larger than the first, or Moss, survey. Jesse did not have a regular surveyor's chain at that time, so he used a rope four rods long. The length of the rope varied due to the dampness often encountered in the Willamette Valley. The stretching of the rope accounts for the none-too-regular size of Oregon City lots. (3) Upon completion of the Applegate survey, the legislature of the newly formed provisional government granted Oregon City a charter. It was the first town west of the Missouri River to be incorporated. It was still the only seat of American government on the Pacific Coast in 1850, when San Francisco was platted. Because of this, the original plat of the City of San Francisco, California is in the office of the county clerk, in the Clackamas County courthouse, in Oregon City, Oregon. (3)

In 1846 Jesse and Lindsay went with Levi Scott and 12 other men on an expedition to locate and blaze a trail which would provide access to western Oregon by way of a southern route. The trail they opened was called the Scott-Applegate Trail. That same year, some of the emigrants who started for the contested Oregon country found, upon their arrival, that the treaty making Oregon part of the United States had been signed. The compromise boundary line which followed the 49th parallel to the Gulf of Georgia, continued through the Strait of Juan de Fuca, and allowed Vancouver Island to remain a British possession, was the peaceful end to the 1844 Democratic Party's warlike political slogan, "54° 40' or fight". (18) Incidently, James Knox Polk was the only candidate for the office of President of the United States to ever use a specific line of latitude as a phrase to unify a political party in an election campaign.

Also in that year, 1846, the frictions that existed between the United States and Mexico became a war. Part of the trouble was that Mexico was unhappy when Texas, having asked to join the Union, was annexed at the end of

1845 and became the 28th state. The war really ended late in 1847, but the treaty fixing the Texas-Mexico boundary at the Rio Grande, was not signed until 1848. (56)

Under this treaty Mexico ceded a vast territory in the Southwest, and the United States gained over three hundred and thirty-four million acres of public lands. This included the present states of California, Nevada, Utah and parts of Arizona, New Mexico, Colorado and Wyoming. The State of Texas retained title to its unoccupied land, and was not a public land state. In 1850 a large area north and west of the present Texas boundary was purchased from Texas by the United States, and this purchase added over seventy-eight million acres to the public lands. This area included parts of New Mexico, Colorado, Wyoming, Kansas, and Oklahoma. (16)

The Gadsden Purchase, in 1853, added about eighteen million acres of public land to the United States. This area became the extreme southwest part of New Mexico and the southern part of Arizona. This part of the United States-Mexico boundary line was run and marked in 1855. (37)

Just before the final battles of the Mexican War were fought, the Mormons, who had suffered much persecution in Illinois and Missouri, made a long westward trek in search of a new Zion, where they might find religious freedom. When they reached the Salt Lake Valley, Brigham Young told his followers that they had found the place. Afterward, the route of the Pioneers, as they called themselves, was known as the Mormon Trail, even though it was used by thousands of other emigrants. About 3 months after the Pioneers started their journey, a group of about 2,000 Mormons left their winter quarters on the west bank of the Missouri. This caravan consisted of 566 wagons and large herds of livestock. With its arrival in September 1847, a colony of nearly 3,000 people had settled at Salt Lake. (18)

That winter, Johann August Sutter needed lumber, so he decided to build a sawmill. One of his employees was James W. Marshall, a carpenter, wheelwright and general handyman, who had

crossed the plains to Oregon in 1844, and gone on to California the next year. It was Marshall who chose the site for the mill. It was built about 45 miles east of Sacramento at a point called Coloma. It was a good mill, but a gravel bar caused water to back up behind the old-fashioned flutter wheel and stop it from turning. The tail-race had to be deepened; and as this was being done, Marshall looked down into the water to see how it was going. He saw a bit of glittering rock in the gravel there at his feet that January morning in 1848. That glittering golden nugget spelled ruin for Sutter (18) who, at the end of the Mexican War, claimed more land than any other one person in the Union. (9)

By the time the treaty with Mexico was signed, Sutter's estate was being invaded and destroyed by the people who flocked to California in the wake of the discovery of gold. Sutter, at one time, claimed the land upon which San Francisco was built, all but a strip along the sea which belonged to the Franciscan Mission. He also claimed the land upon which a lot of other towns, including Sacramento, were built. He had paid the Russians for their vast claims, and that land too, was occupied by others. The value of the gold taken from land he claimed was incalculable. His roads, bridges, ditches, and watering places were taken over and used by the public, and he felt he should be reimbursed for all these things. The difficulty lay in deciding just who should pay, and how much. It was a question of, not one, but many thousands of lawsuits against many thousands of individuals and hundreds of towns and cities, as well as the State of California. He thought that he might also sue the United States. There was no way to obtain judgments against all the people and governments he felt owed him money.

A California Judge named Thompson was able to obtain, from the State of California, a life pension of $3,000 a year for the man who, for a little while, thought of himself as the richest man in America. Most of his pension went to unscrupulous people who said they would help him with "his case". Beginning in

the 1860's, Sutter made various petitions to the United States. Congress did not pronounce in "his case", and he died on June 17, 1880, a penniless, demented old man. (9)

THE PROBLEMS OF PRIVATE CLAIMS

"Remove not the ancient landmark, which thy fathers have set."

Proverbs 22:28

The discovery of gold in California changed the course of settlement in the United States, and with the tide of settlement went the need for surveys. Miners from all over the world found their way into the California mining area almost overnight. The hordes of people who made up the Gold Rush of 1849 were, collectively and individually, trespassers on the public lands of the United States. All they thought of was gold, and they considered gold to be theirs for the taking.

Because of this attitude, the settlements based upon mining were not at all like the more orderly westward movement of the trappers and the farmers. The mining frontier followed a series of new finds, each of which set the miners off in a new direction to another remote area.

As every movie viewer must know, these new discoveries made for tall and wild tales of wealth just waiting for a pick and shovel. Then came the rush, and disillusion for many. If there was enough of the precious stuff,

silver or gold or whatever, a roaring mining town grew and prospered. At least the gamblers and saloon girls, who were anxious to help the miners spend their new-found money, prospered. Then, as happened in California in the late 1850's, the mines gave out. About the time a town had rid itself of the worst of the outlaw element which seemed to follow the miners, it was on its way to becoming a ghost town, unless the people there knew the real treasure when they saw it. The real and lasting wealth was, more often than not, the land.

As the easiest mining ended in California, tales of precious minerals in Colorado lured the miners there. Or to Nevada. Or to parts of Oregon and Idaho. Later, Montana and the Black Hills of South Dakota beckoned. Later still came the rush to the Yukon.

In the face of all this, in 1849, the General Land Office was transferred from the Treasury Department to the Department of the Interior, which had just been created. There was no major change in the responsibility of the General Land Office. It continued to be organized according to functions. Of its nine main organizational functions, the first three were: public lands, surveys, and private land claims. (1)

As the surveys extended into lands that had newly come under American control, the General Land Office and the Federal courts, as well as the surveyors, had to face the problem presented by grants of land made by the previous governments of the areas gained from Great Britain, France, Spain, and Mexico.

These grants extended in size from city lots in such places as Detroit and New Orleans, to grants of a few thousand acres, to Louisiana colonization grants of 200,000 to 700,000 acres, to the enormous Forbes grant of nearly one and a half million acres, in Florida. (16)

The land laws and the systems of measuring the grants of the French, Spanish and Mexican governments were widely different from that of England. The land grants of the French crown were usually described in terms of the arpent, and the Spanish and Mexican land distances were expressed in terms of the vara. (50)

The United States adopted the chain unit of linear measurement. It was the 17th century invention of Edmund Gunter, an English astronomer. Gunter's chain was 66 feet in length, and was divided into 100 links. In its early construction it was made from iron. Later, heavy steel wire was used. This wire was in short pieces which were bent at the ends so that they formed rings. Three extra rings were fitted in between the pieces, so that each assembly made up one whole link, or 7.92 inches (66/100-foot). Handles, which were adjustable and had swivels, were located at the extreme ends, giving flexibility to the whole thing.

From the description it can be seen that there were a lot of surfaces to wear, about six times as many as the number of links. There were also a lot of places for dirt and brush and twigs and muck to get into, causing delays while the chain was cleaned. One of the joys of old-time surveyors must have been finding that a bit of debris they had just removed was poison oak.

The chain required almost daily testing, to make sure the length was correct. It was not replaced, in general practice, by the steel ribbon tape until about 1900.

In the colonies of the English speaking people in America, the land grant boundaries were measured by the chain unit, which is the most convenient one for the computation of areas in acres. One acre is equal to ten square chains. The 20.00 and 40.00 chain public land fractions for the quarter and half-mile distances make the subdivision of sections into aliquot parts, called quarter-quarter and quarter sections, a fairly simple matter. In units of area, these are 40 acres and 160 acres. Ten chains along the section boundary gives the side of a quarter-quarter-quarter unit, or a ten acre subdivision.

The French arpent was not used as a direct linear measure, but tracts of land were described in length and breadth in terms of arpents, the unit meaning the length of the side of one square arpent. In Louisiana, Mississippi, Alabama, and the northwestern

part of Florida, one arpent was very nearly 0.84625 acres. The side of a square arpent equalled 2.909 chains. (50)

The vara is a unit of linear measure used in both the Spanish and Mexican land grants. In the public domain of the southwestern United States, it equals 4.1658 links. One hundred varas are 4.1658 chains or 274.943 feet. (54)

As if this were not enough, the values accorded the arpent and the vara were different in different areas. In Arkansas and Missouri an arpent was 0.8507 acres, and the side of a square arpent was 2.91667 chains, or 192.500 feet. In Florida, one hundred varas equalled 4.2136 chains, or 278.100 feet. (50)

Adding to the problem, was the fact that, from the beginning of American control, there was ample reason for the court to have doubts about the authenticity of many of the grants. In Louisiana Territory, for example, Silas Bent, a government surveyor, reported that the records of his office had "undergone a revolution, there has been Leaves cut out of the Books and others pasted in with Large Plats of Surveys on them...the dates have been evidently altered in a large proportion of the certificates, Plats have been altered from smaller to Larger, Names erased and other incerted and striking difference in collour of the ink etc. ...." His spelling, capitalization, and grammar were imperfect, but his message was clear. (16)

In 1812, the State of Louisiana, formerly the Territory of Orleans, was admitted to the Union. The Territory of Louisiana was, at that time, made the Territory of Missouri. When the Board of Land Commissioners for Missouri Territory made its report that year, it was found that all of the really large claims had been rejected. The aristocrats of the vast fur trading empire, such as the Chouteau family, then exerted all their influence, which must have been considerable, to have the requirements for confirmation of their claims relaxed. Eventually, large grants were confirmed to members of the wealthy fur trading families, but they were only a small part of the land they had once claimed. All of this made more work for the surveyors, because as

grants once confirmed and surveyed were enlarged, they had to be surveyed again. In some cases, due to litigation and legislation, a third survey was required.

In 1814, one of the claims confirmed and surveyed was for 1,000 arpents in Missouri. Daniel Boone received the patent. Before the issuance of that patent, Daniel Boone had never possessed clear title to land in America.

In the territory acquired before 1846, there were 18,643 private claims confirmed in a dozen states. The total area was 10,253,671 acres. (16)

When the treaty with Great Britain ending joint occupancy of the Oregon country was signed, (55) and land from Mexico was acquired under the treaty of Guadalupe-Hidalgo, the private claim problem again reared its head.

Article eight of the treaty with Mexico (56) said: "Mexicans now established in territories previously belonging to Mexico, and which remain for the future within the limits of the United States, as defined by the present treaty, shall be free to continue where they now reside, or to remove at any time to the Mexican republic, retaining the property which they possess in the said territories, or disposing thereof, and removing the proceeds wherever they please, without their being subjected, on this account, to any contribution, tax, or charge whatever.

"Those who shall prefer to remain in the said territories, may either retain the title and rights of Mexican citizens, or acquire those of citizens of the United States. But they shall be under the obligation to make their election within one year from the date of the exchange of ratifications of this treaty; and those who shall remain in the said territories after the expiration of that year, without having declared their intention to retain the character of Mexicans, shall be considered to have elected to become citizens of the United States.

"In the said territories, property of every kind, now belonging to Mexicans not established there, shall be inviolably respected. The present owners, the heirs of these, and all

Mexicans who may hereafter acquire said property by contract, shall enjoy with respect to it guaranties equally ample as if the same belonged to citizens of the United States." (56)

When the American government took over control in California, about 813 private land claims had to be decided. Some grants were very small garden plots near the missions, but the majority of them were from 1 to 11 square leagues. A square league was 4,426 acres. There were also three enormously large claims, one of which was presented for trial, and two of which were, eventually, abandoned. (16)

Most of the grants had been intended for grazing livestock, and were not under cultivation. None were fenced, and most of them lacked boundaries that could be identified. New Mexico, Arizona, and parts of Colorado also had tangled claims left over from the period when Mexico ruled the area.

The United States government had the responsibility of translating the Spanish-Mexican puzzle of incomplete, conditional, unlocated and unsurveyed land grants into a vastly different land system, one which recognized only fee simple titles or the type of conditional rights which had obligations that had to be fulfilled before title could be issued. (16)

Surveying these claims was also made difficult by the necessity of reconciling them with the American system of townships and ranges. Finally, the rectangular surveys were fitted around the older grants, no matter what their origin, shape, or size, or in what direction they lay. Many odd corners were produced by the closing of the rectangular surveys against the lines of these claims.

The settlers in Oregon had passed an act which created a provisional government 3 years before the signing of the treaty setting the northern boundary at the 49th parallel. Under that law, any man was permitted to hold 640 acres wherever he wanted to establish a claim. The 1848 Organic Act creating Oregon Territory, which voided "All laws heretofore passed in the said Territory of Oregon making grants of land or otherwise affecting or encumbering the

title to lands...." was, therefore, most upsetting to Oregonians.

Their distress must have communicated itself to Congress, because in September 1850, another Donation Land Law was passed. It was "An Act to Create the office of Surveyor-General of the public lands in Oregon, and to provide for the survey, and to make donations to settlers of the said public lands." This law granted 320 acres to every male settler (including American half-breeds) over the age of 18 who was a citizen or who had declared his intention to become a citizen before the 1st of December, 1851, and who had lived in Oregon Territory and cultivated the land for 4 consecutive years prior to December 1, 1850. If he married by the 1st of December, 1851, his wife was entitled to a grant of a like amount of land to hold (wonder-of-wonders) in her own right! At that time, it was a very uncommon privilege for a wife to be allowed to have real property in her own name.

The white male citizens or intended citizens who emigrated to Oregon Territory between December 1, 1850, and December 1, 1853, and who met the other obligations required by the act, were to have 160 acres, if single, or 320 acres, if married. (16)

One minor thing might be noted regarding the Donation Land Law. Almost half of the claimants were married in Oregon. The double allotment of land may have had almost as much to do with that fact as the romantic character and loving nature of Oregon pioneers.

The Donation Land Law did not clarify titles right away. It applied to unsurveyed lands not offered for public sale. The purpose of the law was to protect the bona fide settlers until they had filed claims and received patents. After this was accomplished, the remaining lands, once they had been surveyed, came under the regular laws dealing with the sale of the public lands. (21)

Under the law, if the land was "deemed unfit for cultivation," only township lines were to be run. In other cases, only "necessary" lines were to be surveyed. A settler's request

for a survey, in the case of individual land claims, made those surveys "necessary" since that was the only way they could get clear title, or patent, to the land.

In 1851, the Willamette Meridian and Base Line were established, and the survey of townships and ranges in the most heavily populated areas was started. Even so, since the law had provided no required time for the donation land claimants to complete their title, they often were in no hurry to do so. In 1857, the Secretary of the Interior stated in his report that "not having been empowered to hasten the surveys of private land claims,...[surveying] in many townships goes on tardily, because settlers still withhold their requests for surveys."

Because of this, much of the settled land was held under incomplete rights. As always, surveys were necessary before the sale of public lands, so no public lands were offered for sale in Oregon until 1862. (21)

In other areas, particularly in the Southwest, private land claims delayed the extension of surveys into surrounding land, and thereby kept those lands from being entered and settled. Often, when the claims were not valid and were not confirmed, the most desirable lands were affected. The fact that they were held back from survey and settlement sometimes retarded the development of a whole area.

The English-European heritage of the American government made it extremely aware of property rights, and all claimants were given the advantage of every opportunity to prove the validity of their claim to land. In all, 34 million acres of land in 19 states were confirmed to the holders of private claims. (16)

THE RUGGED YEARS; THE HARDSHIPS

"I lifted up mine eyes again, and looked, and behold a man with a measuring line in his hand."

Zechariah 2:1

The Act of March 4, 1909, restated the ancient Biblical admonishment against the removal of landmarks. It said it this way: "Whoever shall willfully destroy, deface, change, or remove to another place any section corner, quarter section corner, or meander post, on any Government line of survey, or shall willfully cut down any witness tree or any tree blazed to mark the line of a Government survey, or shall willfully deface, change, or remove any monument or bench mark of any Government survey, shall be fined not more than $250, or imprisoned not more than six months, or both."

Corrective resurveys had been authorized from time to time since the early years of the public land surveys, but the Act of March 3, 1909, as amended June 25, 1910, authorized extensive resurveys of the public lands, so that they might be properly marked. The Act provided that no resurvey was to be executed in such a way that it could impair the rights of the claimants of the lands affected. Resurveys were to be executed at the discretion of the Commissioner of the General Land Office. Following the passage of this Act, surveyors

have, from time to time, been assigned the challenging job of retracing lines established by the men who surveyed before them.

In all resurveys the application of legal principles and statutory acts regarding the location of surveyed lines are important and perplexing considerations. The bewilderment caused by the gradual changes in the execution of our survey system are well known to anyone who has attempted to "follow in the footsteps" of a man who surveyed over a hundred years ago, within boundary lines that are not the same as they once were, according to laws and instructions that have changed, and under conditions that no longer exist.

For example, in 1834, Abraham Lincoln laid out the original 15 blocks of a small, Mississippi River town called New Boston, Illinois. In later, years, the town of New Boston grew into a disordered puzzle of streets which met the streets of the original town survey at unorthodox curves and angles. For many years people speculated about the "crooked" original survey.

John B. Freund, a registered professional engineer and land surveyor from Illinois, and William Gordon, a survey party chief, speculated about it too. Some 130 years after Lincoln completed his survey, they decided to retrace Lincoln's steps to see why he surveyed it the way he did.

They found out that he used perfectly acceptable surveying practices, and that it was only subsequent events that caused the streets laid out by Lincoln to appear to be crooked. Lincoln used the Mississippi River as a boundary line. This was common practice in the early 1830's, and if his lines are retraced from the River, they are quite straight and true, considering his lack of modern equipment. As the area around the town was surveyed into townships and ranges using the cardinal directions, instead of the curve of the river, the resulting roads and streets were connected to the old streets of the town in such a way that the lines surveyed by Lincoln appeared crooked and angular. (40)

Mistaken ideas about correct procedure have also been held by surveyors from time to time. In 1856, for example, even though there was plenty of accurate information available, Thomas A. Hendricks, then Commissioner of the General Land Office, gave the following inaccurate rule for locating the center of a section: "Run a true line from the quarter-section corner on the east boundary, to that in the west boundary, and at the equidistance between them establish the corner for the center of the section." (14)

This same erroneous opinion was given earlier by the surveyor general of Missouri and Illinois. The courts did not agree, nor did the General Land Office in any of its rulings, so far as can be determined. In 1868, this incorrect rule was explicitly set aside by the Secretary of the Interior, but not before it had been followed by a number of deputy surveyors in both Illinois and Missouri. (14)

When the job of retracing a long-ago survey is to be undertaken, the surveyor should take several factors into consideration. Such things as the weather, the equipment in use at the time of the original survey, and the disposition of the local Indian tribes may have had a direct bearing upon how a survey was done.

Early surveyors accepted hardship and danger as part of the job. They walked a path that was straight, narrow, and not chosen for its easy travel. Sometimes amusing stories or tales of exciting events show up in reports or letters. Even the field notes may give small glimpses of the everyday life of the surveyors. Sometimes the field notes give scanty, unembellished accounts of high adventure. Records of surveyors' experiences are usually short and disconnected. They tell of such things as camp life, rough country, storms, prairie fires, swamps, or hostile Indians. They have the ring of truth.

Deputy surveyor, Harry A. Wiltse, once wrote a first-hand description of life on an 1847 Wisconsin survey. The survey lines ran through many miles of insect-infested swamp. In order to do their work the surveyors had to carry

all their food and equipment on their backs as they waded through high water, and climbed over fallen trees. For four long weeks they endured attacks by clouds of mosquitoes. Their clothing was wet both day and night. Finally, they ran out of food, and had to make a forced march in search of provisions. Wearing clothes that were nearly rotted away, they struggled for 3 days to reach a place where they could find food. During that 3 days they had nothing at all to eat. Little wonder that Harry A. Wiltse closed his written account of this survey by stating that he "would not again, after a lifetime of experience in the field, and a great fondness for camp life, enter upon the same, or a similar survey, at any price whatever." (32)

Apparently, Harry was not the only member of the Wiltse family who worked on the surveys of the public lands. Records show that in 1844, both Harry A. Wiltse and Samuel C. Wiltse held survey contracts in Iowa, (14) and in 1871-1872 a surveyor named Wiltse held contracts in Nebraska. (51) The records, however, did not reveal their relationship to one another.

By the middle 1850's, the active period of public land surveys had ended in Ohio, Alabama, Arkansas, Illinois, Indiana, and Missouri. Iowa public land surveys were three-quarters finished, as were those in Michigan and Mississippi. The surveys in Florida, Louisiana, and Wisconsin were somewhere near the halfway mark, and those in Minnesota, California, Kansas, Nebraska, New Mexico, Oregon, Washington and Utah had been started. (32)

The survey of the Nebraska-Kansas boundary, which is the base line of the Sixth Principal Meridian, was started in 1854. The line was run and marked, mainly with small wooden posts, for 108 miles westward from the initial point (52.55 chains west of the right bank of the Missouri River, on the 40th parallel). The cast iron monument for the initial point, was set in 1855. Its marks read: "NEBRASKA" on the north; "1854" on the east; "40° N LAT" on the west; and "KANSAS" on the south. When the line was resurveyed and re-monumented during 1855-56, the former markers were destroyed.

The line was extended from the 108th mile westward to the Rocky Mountains in 1858-59, as a base line of the surveys of the public lands. (37)

Field note records of some original surveys executed in Kansas yield interesting insights into conditions. Consider this for an example of a good explanation for a delay in completing a survey contract: "....we would state that on or about the 1st of August, 1854, we repaired to the field of operations prepatory to executing the contract. On arriving in the field we found our work was immediately in the vicinity of headquarters of the hostile Indians and after skirmishing with us 2 days, they fired the prairies, completely demolishing everything for our cattle to subsist on for many miles, in fact the whole country lying between the Solomon and Republic Rivers, and we were forced to abandon our work." (85)

Here is another: "At this place a party of Indians fired on me and my men. Their design was to kill me; they had previously threatened to shoot me and my men if I did not quit surveying there. A shell struck a tree against which I was leaning at that time, while my compass needle was setting not 6 inches from me." (85)

Deputy M. McManus from Sangamon County, Illinois, had a contract to survey in Nebraska Territory in 1855. He wrote a letter that December to the surveyor general, John Calhoun. (John Calhoun was the name of the man who hired Abraham Lincoln; it may have been the same man.) In the letter he told that one of the mules had broken its neck. He went on to lament about the troubles he had experienced on the survey and noted that it was surely not the same matter as retracing old lines in Sangamon County. (13)

In 1855 the surveyor general of Michigan filed a report dealing with the swamps and the weather. "....a considerable portion of the surface of the country is low and swampy... In consequence of frequent rains the country has been rendered unhealthy, and nearly every

party has suffered by sickness, and in one instance, by death. The duties have been so laborious that men have in some cases become refractory and left the field, making it necessary for the deputies to abandon their work for a time to engage new assistants." (32)

In Oregon, in 1855, deputy surveyor Harvey Gordon reported that he had run into unexpected problems. (48) He had been "obliged to carry my camp equipment on men's shoulders....over the coast mountains, which are inaccessible to horses." He went on to say that after that hike, the men "....were unable to continue the work. I accordingly suspended operations to form a new party, but before I could do so the entire laboring portion of the community was seized with the gold panic....". Wages climbed from 52 dollars to 100 dollars per month, and he could not find good men even at that inflated wage! (32)

In Nebraska and Kansas that same year, 1855, the trouble was Indians. The surveyor general reported: "The progress of the surveys under my charge has been suspended...on account of the positive refusal of the Pawnee Indians to allow us to proceed....Some Indians (chiefs)... ordered us to leave....and backed their orders with repeated threat that every man who did not leave the survey before the sun should arrive at meridian should be shot...They then pulled up all the posts set on the north side of the river, told us they would destroy all of the landmarks made in the vicinity, and that we must and should leave."

There was an Indian war in what is now Washington State in 1857. The surveyor general's report stated: "The paralysis caused by the Indian war, the scarcity of men and general impoverishment of the inhabitants, including the few land surveyors of the country, together with the exceeding topographical difficulty of the country, has made it impossible to find deputies willing to contract for any work other than that reported." (32)

In 1856, John S. Zieber, the surveyor general of Oregon, called attention to the rugged scenery: "The public lands which remain to be surveyed in Oregon are probably rougher than any that

have been sectionized in the Territories of the United States. Scarcely an unsurveyed township of land can be found without canyons, ravines, or precipitous hills; and most of the unsurveyed territory abounds in heavy timber (often standing and fallen), dense tangled undergrowth of bushes, briars, fern, and grass, in many places covering a rocky surface almost impassable." (48)

In 1860, Abraham Lincoln received a patent for 160 acres of public land for his services in the Black Hawk Indian Wars. In November of that year he was elected President of the United States. Shortly afterward, three new surveying districts were established, and surveys began in Colorado, the Dakotas and Nevada. (1)

On April 25, 1862, the 50th anniversary of the founding of the General Land Office was celebrated. Less than one month later, May 20, 1862, Congress passed the Homestead Act.

The Homestead Act fairly shone with generous western spirit. To acquire a patent to 160 acres of public land, only residence, cultivation, and some improvement upon it was required. After 5 consecutive years, the homesteader could apply for and receive a patent to the land for the cost of the $15 filing fee. If he preferred, the homesteader could, after 6 months, purchase the land at the rate under which it was held, $1.25 or $2.50 per acre. Homesteading was open to anyone who was the head of a household or 21 years of age, and who was or intended to become a citizen.

Homesteading was not permitted on unsurveyed lands. In spite of previous preemption laws, and the lack of a positive prohibition of it, homesteading on land that had not been surveyed was not legal until 1880. (16)

The Homestead Act went into effect on the same day President Lincoln issued his Emancipation Proclamation, January 1, 1863. (1)

Something of western travel conditions in the early 1860's may be learned from an account written by Benjamin Randall who left Boston, to take care of business in Colorado, during

the summer of 1862. (75)

He was 20 years old, and enthusiastic about his adventure as he traveled by rail as far as Atchison, Kansas. There was no railroad across the prairie west of the Missouri River, so he was interested to learn that the Butterfield Overland Dispatch Route had just sent its first stagecoach from Atchison to Denver. He was on the second one when it left on September 29th. (75) It was a Concord coach, the most popular type of stagecoach in the west. Its name came from its place of manufacture, Concord, New Hampshire. It was said to be the most comfortable vehicle of its era for travel over unpredictable roads. Its swaying, ship-at-sea motion was due to the fact that the coach body was suspended on heavy straps attached to rocker springs. (13)

Inside the coach were two seats, one facing frontward, the other backward. A removable third seat was often placed between the other two. With three seats in place, it was considered a 9-passenger vehicle. The driver sat in front of the coach, feet forward against the footboard. On the floor in this section were carried tools, a water pail, a buffalo robe, and the strong-box. The baggage section projected from the rear of the coach and was covered with canvas or some other sturdy material. Extra baggage and mail sacks were carried on top of the coach. They were held there by a railing around the roof. (13) The Concord coach that carried young Randall had three seats, and was pulled by four good horses. There was a new road across the rolling prairie, so they reached Topeka at 10 o'clock that night. (75)

They ate supper and started out again. That night he traveled through his first Indian country, the Potawatami Indian Reserve, so he did not sleep much. They changed horses at St. Mary's Stage Station at 4 o'clock the next morning.

They reached Salina, "the last house on the plains", at 3 o'clock the following morning. For the next 400 miles, there was nothing but open country and the huts where the herders for the stage teams stayed. He described the

first of these huts as being "two forked sticks five feet long stuck in the ground and a stick laid from one to the other so that when he [the herder] threw his blanket over the cross stick it made an 'A' tent".

As the teams were being changed, the station herder told them there had been no return stage. The herder was sure the Indians had "inspected" it. At this point, Randall noted that a party of U. S. Government surveyors were killing rattlesnakes nearby. The stagecoach continued on. Later they came across the missing stage passengers and driver, who had taken refuge with a wagon train. The stage had, indeed, been "inspected" by the Indians at Monument Rocks Stage Station.

In order to have help sent to the wagon train and its guests, Randall's stage started back toward Atchison. Along the way they saw "immense herds of buffalo". They reached Rushton Stage Station at 6 o'clock in the evening, and met a Government survey party. This time the surveyors had a cavalry escort. The stage driver and his passengers were hungry, so the surveyors treated them to a meal of buffalo steaks.

The people on the stage took a different route and had no more trouble on their way to Denver. One assumes that the survey party, still surrounded by hostile Indians out on the remote, rattlesnake-infested Kansas prairie, went right on with its surveying. (75)

In 1863, in Washington Territory, a deputy surveyor named Edwin Richardson tried a somewhat unusual method of marking his corners. The survey was in the Pasco-Richland area.

Richardson's field notes show that he used a stake that had been charred (for durability) for each of his corners. He dug trenches and pits to witness the corners he set. He also used an additional marker. Perhaps he wanted to make sure the corners would be easy to find. (88)

It is also possible that he was following the suggestion found on page 11 of the 1855 Manual of Instructions. Under the heading "Mound memorials" it was recommended that a deputy

surveyor "plant midway between each pit and trench, seeds of some tree, Those of fruit trees adapted to the climate being always preferred, so that, in course of time, should such take root, a small clump of trees may possibly hereafter note the place of the corner. The facts of planting such seed, and the kind thereof, are matters to be truthfully noted in the field book"

Whatever his reasoning, Edwin Richardson's field notes show that he planted 1,448 tree seeds during the course of his survey. He used a variety; apple seeds, wild cherry stones, white thorn, peach pits and oak acorns. He planted several seeds at each corner, but apparently had little success as an orchardist. So far as is known, not even one of the trees planted by deputy surveyor Edwin Richardson has ever been found. (88)

The same year that surveyor Richardson planted tree seeds at his corners, a surveyor general was appointed for the newly created Territory of Arizona. He started for Arizona, but the Report of the Commissioner of the General Land Office for that year stated that "no report has been received from him since his departure." Apparently, they never did hear from him, because the job of selecting the initial point for the Arizona surveys fell to the surveyor general of New Mexico, John A. Clark.

On May 24, 1865, Clark made the following report: "Immediately opposite the mouth of the Salado on the south side of the Gila, there is a conical hill about one hundred and fifty feet in height, upon the pinnacle of which Mr. Bartlett, in making the survey of the boundary line under the treaty with Mexico of Guadalupe Hidalgo, established a corner 'to mark the mouth of Salt River'. I visited this monument and found it compactly built of stone, circular, about eight feet diameter at the base, four feet at the top, and eight feet high, with a post four inches in diameter projecting from the center of the top about six feet, upon which is marked: 'United States and Mexican Boundary Survey, 1851.-This monument erected in 1851 to mark the junction of the Gila and Salt River.-A.H. Gray, U.S. Surveyor.' The

hill upon which the monument is erected is...a remarkable landmark: and being...opposite the mouth of the Salado or Salt River-the geographical position of which has been determined - and, with respect to the arable land of Arizona, being very central, I have selected it as the initial point for the Meridian of that Territory." (86)

The "conical hill" is a short distance southwest of Phoenix. It is named Monument Butte. It was from the monument selected by John A. Clark that the Arizona cadastral survey grid was extended.

On January 19, 1867, William H. Pierce and a party of four men began the survey of the Gila and Salt River Base Line. They surveyed eastward, and in 4 days they had completed 36 miles along the route of present-day Baseline Road.

In 1911, United States surveyor Guy P. Harrington, made surveys from this Initial Point. He took pictures of the hill and the monument. For many years afterward the monument remained intact.

In 1945, a cadastral engineer named Ty White, made the tie from a nearby triangulation station to a point which he identified as the Initial Point. A picture was taken then, too. It showed Ty White and field assistant John Boggs standing in a depression. Rocks from the handsome mound described by surveyor general Clark 80 years before are shown scattered about, instead of piled neatly as they were for so many years. (96)

On April 25, 1962, the 150th anniversary of the founding of the General Land Office, a historical monument marking the point of beginning for the cadastral survey of the public lands of Arizona was dedicated. It is not a grand heap of stones, as was that first monument. It is a standard brass-capped iron survey post, set in a short, slightly tapering, concrete pillar. One side of the small obelisk bears a granite plaque which tells the nature of the marker and lists the important dates concerning its history. (93)

During the Civil War, before John A. Clark chose the Initial Point for the Arizona surveys, the need for a connecting link between the isolated Pacific coast and the eastern

part of the Nation became evident. Out of this need came the grants, in the latter half of the 19th century, of extensive portions of the public lands to aid the construction of a transcontinental railroad and telegraph system. The grants were for the rights-of-way, plus alternate sections of land. Some of the land granted to the railroads was sold to settlers. Other people settled on the alternate sections of public land along the route of the railroads.

The Act of July 2, 1864, under which land was granted to the Northern Pacific Railroad, provided "That the President of the United States shall cause the lands to be surveyed for forty miles in width on both sides of the said road, after the general route shall be fixed, and as fast as may be required by the construction of said railroad....". The route for the railroad was selected by railroad surveyors, but the railroad land grant surveys were public land surveys. They were executed by United States deputy surveyors. (43)

Certain odd-numbered sections of the public domain in western Oregon were granted to the Oregon and California Railroad Company in 1866. The terms of the grant were violated, and Congress, in 1916, ordered the remaining unsold part of the grant returned to public ownership.

The checkerboard pattern of O&C revested lands, along with the revested Coos Bay Wagon Road grant lands, include something over 2-1/2 million acres of the most valuable and productive timber lands in the United States. (78)

The Union Pacific and the Central Pacific Railroads were the first to receive land grants. When they met at Promontory Point, Utah, on May 10, 1869, a golden spike was driven, It was attached to the telegraph system in such a way that the contact of the hammer's blow, as the spike was driven to join the two sets of rails, sent a signal across the nation from the Atlantic to the Pacific. (13)

During the time these railroads were under construction, William Henry Seward, then Sec-

retary of State, negotiated with Russia for the purchase of Alaska. On June 20, 1867, the transaction was completed, and the United States added more than 365 million acres to its public lands. (16)

While all this was going on, homesteading was coming into its own and the surveyors were kept busy executing needed surveys and overcoming hardships. During the latter part of the 19th century, the fires that sometimes swept over the prairie land were often a hazard. In Nebraska in 1872, a surveyor named W. E. Harvey, suffered a great loss from such a fire. On the last day of July, while his cook went to the river for water, the prairie grass caught fire and burned all their clothing, bedding, and most of their provisions. Surveyor Harvey counted himself lucky because he was able to save the field notes. (13)

Water, was also a problem. Moses K. Armstrong, on a survey of the south line of Dakota, had too much. He wrote that he was "quite sick with a cold from wading so much in mud and water."

At other times, there was too little water and it had to be hauled many miles. Deputy surveyor W. A. Richards once wrote: "Old Jim [a mule] tipped over on a side hill but did nothing worse than smash a water pail which is bad enough in this country." (13)

W. A. Richards kept a journal on a survey of the southern boundary of Wyoming. The contract for the survey was held by Alonzo V. Richards, (51) but W. A. Richards was, apparently, a member of the survey party. The September 16, 1873, entry describes an evening in a survey camp. (13) The camp was a temporary shelter of boughs, located in the woods, with a blazing pine-log fire in front of it. The mules were tied at one side of the bivouac for the night. The other side was occupied by their packs. A nearby tree was decorated with a dressed-out deer. The men of the survey party were sitting by the campfire playing their nightly game of euchre (a card game).

In his journal, Richards also mentioned having copies of "Harpers Weekly" with him, and he noted that he had also read "Martin Chuzzlewit,"

"Tom's Vindication", and "Nicholas Nickelby" during that summer survey season. (13)

This brings up a particular point about early-day surveyors. While many of them became expert woodsmen, plainsmen, and mountaineers, they were not really like most of the trappers and cowboys who lived a similar frontier life. The surveyors were, for the most part, not born to primitive conditions. They were often among the best educated men of their time. Some of them were used to luxury, and a great many of them had known the pleasures of a well-ordered, comfortable existence. The two-sided world to which they adapted was of their own choosing. They chose an exhausting and exciting life of adventure in the marking of America's frontier lands, even though for a number of them life in civilized society was as familiar as salt pork and beans in a survey camp.

With all their problems, most surveyors fared better than did deputy surveyor Nelson Buck. Mr. Buck had been a surveyor for over 30 years (13) when he made application, in 1867, to survey the area from Red Willow and Frontier Counties in Nebraska westward to the Colorado line. The application was refused because of the hostility of the Indians in the area. (71)

Mr. Buck wrote again in early 1868, and explained that he would have a large survey party. He felt sure they would be able to protect themselves. He also mentioned his long and successful career as a frontier surveyor. The officials relented; and on June 29, 1869, the newspaper in Plattsmouth, Nebraska stated that Mr. Buck had received the surveying contract. When he arrived in Plattsmouth, Mr. Buck hired two teamsters and bought provisions. He arranged for wagons and teams, and started out for Fort Kearney.

Mr. Buck wrote a letter on July 21, 1869. It was mailed from Fort Kearney. In it he mentioned that he had not obtained the arms and ammunition at the Fort that he had wished to take with his party. He also wrote that reports of more trouble with the Indians had caused some of his men to take other employment.

That letter was the last anyone ever heard from Mr. Nelson Buck or the men who were with him when he started his survey. In October it was found that no corners had seen set. No evidence of any survey work could be located, nor could the survey party. Later, a place where the survey party camped was found, silent witness to what must have taken place. The camping equipment was there, as were tripods, part of a wagon, canned goods, and a silver spoon with the name James Jackson engraved upon it. The campsite was less than 40 chains north of the Kansas line, about 4 miles southwest of Danbury. (71)

In November 1869, a Nebraska deputy surveyor, W. J. Allason, had encountered several difficulties, and found himself face to face with ruin. He felt that the surveyor general was not sympathetic, so he wrote him a letter. In it he said that he could not "....see what satisfaction you [the surveyor general] can reap by taking advantage of the misfortunes of one who has nearly all he is worth in this one contract. I had to correct a mistake in my line and was hindered on account of high water and to cap the climax I was burnt out. And now you are so I learn trying to get the Commissioner to claim the forfeit of my bondsmen and annul my work altogether. God knows I never did you any harm by word or deed and if you cause my ruin by what may be your legal power may your future happiness and prosperity be in accordance with its justice." (13)

THE RUGGED YEARS; THE SUCCESSES

"Thus he shewed me: and, behold, the Lord stood upon a wall made by a plumbline, with a plumbline in his hand."

Amos 7:7

Instructions about initial points did not appear in Tiffin's instructions, the Oregon Manual of 1851, or in the Manual issued in 1855. It was not until the Manual of 1881, that initial points were mentioned, and general instructions given regarding their establishment.

Even so, these points had always been chosen with care. The Point of Beginning for the survey of the Seven Ranges was designated in the Act of May 20, 1785. Letters of instruction to various surveyors general also pointed out the importance of these points through which only principal meridians and base lines may pass.

On May 5, 1851, John B. Preston, newly appointed surveyor general for Oregon, arrived in Oregon City. He had crossed the Isthmus of Panama with his valuable surveying instruments strapped to the backs of pack animals. (42) Mr. Preston was accompanied by James E. Freeman and William Ives. Mr. Ives' brother, Butler Ives and George W. Hyde, who was Mr. Preston's brother-in-law, were also with them. All of

these men were experienced surveyors. (38)

Mr. Preston let contracts for the first surveys of Oregon public lands, and established the Initial Point of the public land surveys in Oregon, as he had been directed. He chose a point in the hills just west of Portland, and marked it with a cedar stake on a day in early June 1851. This Initial Point, the intersection of the Willamette Meridian and its Base Line, is now carefully monumented in an area set aside as Willamette Stone State Park.

In choosing the Initial Point, Mr. Preston followed the instructions given to him by Justin Butterfield, Commissioner of the General Land Office. He used great care in selecting the place from which original surveys were extended for over 100 million northwest acres. Farms and fields and forests from the California boundary to the Canadian border are described as east or west of the Willamette Meridian, and north or south of its Base Line.

Preston wrote a letter to the Commissioner of the General Land Office on June 14, 1851. It explains exactly why he designated what now appears to be a somewhat obscure spot in Portland's west hills as the point of beginning for the surveys of the public lands of Oregon Territory.

"Surveyor General's Office
Oregon City, June 14, 1851.

"Hon. J. Butterfield, Commissioner,
General Land Office.

"Sir: I have the honor to transmit herewith a contract made with James E. Freeman, Esq., for surveying the Willamette meridian from the base line south to the Umpqua valley, and a copy of the special instructions given him. I also transmit a contract made with William Ives, Esq., for the survey of the Willamette meridian north of the base line to Pugets Sound and the base line from the Pacific Coast to the summit of the Cascade mountains, and a copy of the special instructions given him.

"Previous to making these contracts I organized a party and visited the Columbia river and found it necessary to go as far east as the

Cascade mountains in order to determine the point to start the base line so as to 'avoid its southerly bend.' After determining this I made a partial examination of the country near the mouth of the Willamette to find a proper point to cross with the meridian line. In the examination, I found that there was one small lake that would interfere but considered this much less of an obstacle than the broken country the line would have to pass over if thrown west of the lower mouth of the Willamette near St. Helens. Also believing that if the line was changed to the east there would be greater danger in running into the broken country at the foot of the Cascade mountains, I determined to locate the line on the point designated in the map accompanying your instructions. The point of intersection of the base and meridian line is 3-1/2 miles west of Portland. The base line will run through Portland on the Willamette and Hillsboro in Tualatin plains, 15-1/2 miles west of Portland. The meridian will run about five miles west of Oregon City. If the deputy surveyors find difficulty in getting men to assist them, the farmers are now offering $5 and $6 per day for men to assist in harvesting.

"In order to advance the surveys, it will be necessary to give out some contracts for surveying township lines before the surveys of the base and meridian lines are completed. I have therefore desired the deputies on those lines to return their notes after they have surveyed 75 miles each. After these notes have been approved will get out contracts for surveying 25 township lines.

Very respectfully, your obedient servant,

JNO. B. PRESTON,
Surveyor General."

In his letter, Mr. Preston speaks rather casually of "visiting" various areas in his examination of the country to determine the site of the Initial Point. It would perhaps be well to remember, however, that except for the emigrant trails and a few settled areas in the valleys, there were no roads in Oregon Territory in 1851. At that time the rivers were the main highways of the Oregon country. There was an old Hudson's Bay Company cattle trail

across the hills to the Tualatin Valley, but it was not until 1853, that a corduroy road up Canyon Creek was completed. This was an all weather road built of logs laid side by side which connected Portland with the nearby Tualatin Plains. (21)

The men who came to Oregon Territory with John B. Preston were all men whose work had recommended them. James E. Freeman had been a deputy surveyor in Wisconsin (38) and Iowa. He held public land survey contracts in Keokuk and Van Buren Counties in Iowa in the early 1840's. (14) It was during this same time that William Austin Burt and his sons also surveyed in Iowa, Wisconsin and Michigan.

The survey plats of T. 58 N., R. 27 W., and T. 58 N., R. 28 W., in upper Michigan are among those signed by William Burt (township lines) and D. Houghton (subdivisions). The field notes of these two townships reveal that the township lines were run by Austin Burt, for his father, and the subdivisions were done by a surveyor named William Ives for Dr. Houghton. (58)

These surveys were done at a time when the General Land Office needed to know which lands were mineral lands in order to reserve them from sale, so the plats show comprehensive geological notations.

In the early 1840's, Lucius Lyon, the surveyor general of Ohio, Indiana, and Michigan, issued contracts to Douglass Houghton, the first Michigan State geologist, and to William A. Burt. Under the contracts, geological surveys were to be executed during the course of the regular cadastral surveys. (72)

The survey plats, including those of areas in which the geological work was done by William Ives for Dr. Houghton, show that it could be done.

After Dr. Houghton's untimely death in 1845 (72), the Burts and Mr. Ives continued to survey in upper Michigan. On April 23, 1847, William Ives signed a contract with Lucius Lyon for the survey of 680 miles at 5 dollars per mile. The area included the easterly half of Isle Royale in Lake Superior. The Surveyor

General's report of November 5, 1849, indicates that these surveys were all completed. (68) That year, as many men rushed to California in search of gold, William and Austin Burt and William Ives surveyed T. 48 N., R. 48 W. in the upper penninsula of Michigan.

Undoubtedly, this William Ives was the same man who traveled with Mr. John B. Preston to Oregon Territory 2 years later. It is also fairly certain that Mr. Preston, the Ives brothers, Mr. Hyde and Mr. Freeman were all familiar with the use of the solar compass, since by that time it had been used for about 15 years in surveys of the public lands.

When James E. Freeman started south on the initial survey of the Willamette Meridian, a young man named Zenas Ferry Moody was a member of his survey party.

Zenas F. Moody was the grandson of a Revolutionary War soldier. He was born in Granby, Massachusetts on May 27, 1832, and when he was 18 years old, he traveled to Oregon by way of Panama. He arrived in Oregon City in April 1851. Just after his 19th birthday, he went to work as a chainman on the first United States survey in Oregon Territory. (22)

Freeman's party surveyed the Willamette Meridian from the Initial Point south "to the Canyon Mountains." (22) James E. Freeman was, according to surveyors who have retraced his lines, one of the best of the early surveyors. His work is considered excellent even by modern standards, as is the work done by William Ives, who initiated the survey of the Willamette Base Line, in 1851. (68)

On Tuesday, June 10, 1851, another adventurous young man arrived in Oregon City. His name was Kimball Webster, and he was from New Hampshire. In 1849, he had less than unqualified success in seeking his fortune in the California gold rush, and in 1851, he started north. (38)

Kimball Webster had studied some of the subjects necessary for qualification as a surveyor, so he was disappointed to learn that the survey parties were already at work, and had

left the area near Oregon City. Later on that year, Kimball Webster went south to join the Freeman party.

George W. Hyde was with James E. Freeman when young Webster arrived, but he left soon afterward. Zenas Moody was still one of the chainman and Kimball Webster became the axeman. According to Mr. Freeman, Webster was doing a good job as axeman when Mr. Freeman found out he had studied mathematics and was well versed in trigonometry. Mr. Freeman was not an expert mathematician; but he was something more rare, a man so dedicated to doing a good job that he encouraged the men on his surveys to learn, assist him, and advance in their own careers.

When Webster first joined the Freeman party, Mr. Hyde was assisting Mr. Freeman in making calculations. After he left. Mr. Freeman found out about Webster's background and asked him to assist in making calculations. Mr. Freeman worked problems out by traverse tables, and Webster worked the same problems by logarithmic tables. They usually agreed on the answers, but if they did not agree, they rechecked. It was soon apparent that if there was an error, it was usually in Mr. Freeman's work using the traverse table. As soon as Mr. Freeman knew he could count on Webster's work, the job of making calculations became Kimball Webster's job. (38)

If one reads the field notes of Mr. Freeman's Oregon public land surveys, a record of the progress of the men of the survey party becomes clear. The field notes tell of both Zenas Moody's and Kimball Webster's education in the survey of the public lands. They were axemen, flagmen, markers, assistants, and instrument men. Over a period of time, they held all the jobs that would help them understand cadastral surveying. They were ambitious enough to continue their studies, but the opportunities to use what they had learned were opened to these young men by James E. Freeman. It is to his credit, as well as theirs, that both Zenas Moody and Kimball Webster became competent surveyors and soon held survey contracts in their own names.

In March of 1852, Kimball Webster was employed on a contract held by Robert Elder. Mr. Elder was the chief clerk in Mr. Preston's office when Webster first met him, shortly after his arrival in Oregon City. By 1852, Webster had acquired a solar compass. It cost him 350 dollars. (38)

Kimball Webster received his appointment as a United States deputy surveyor on April 25, 1852. By coincidence, this was the 40th anniversary of the establishment of the General Land Office. In June 1852, a survey contract was issued to Elder and Webster. Under this contract, the two men operated a joint party. Kimball Webster received something over $100 per month for his work. Webster's first contract in his own name was issued in December 1852.

John B. Preston, a member of the Whig Party, (forerunner of the Republican Party) gained his office as surveyor general by political appointment. He was, however, unlike many surveyors general of that time, a qualified engineer and surveyor. Mr. Freeman, the Ives brothers, and Webster were all Democrats, but when Franklin Pierce was elected President in November 1852, and Mr. Preston was replaced by Colonel C. K. Gardiner, Kimball Webster considered it a very poor exchange. Webster thought Col. Gardiner "a good man in his place," but he also felt that Gardiner "knew very little in regard to the public land surveys." (38)

Incidentally, the election of Franklin Pierce was the same election Ira Cook and his party had no word of on their survey in Iowa in 1852.

Young Zenas Moody stayed with the Freeman survey party until 1853. During the time he worked under James E. Freeman, he met pretty young Mary Jane Stephenson, an orphan who had worked her way across the plains from Illinois in 1852, when she was 16 years old. She was only 17 when she and Zenas were married in Linn County, Oregon in 1853. It was a happy marriage that lasted for more than 60 years. The Moody's had four sons and a daughter. (47) Just as a matter of interest their second son, Zenas A. Moody, married Catherine Doherty, the first white girl born in what is now the State of Washington. (46)

By the spring of 1854, Robert Elder had returned to his home in Illinois, and Mr. Freeman had gone to California to work on the public land surveys there. (38)

Zenas Moody became a deputy surveyor in Oregon in 1855. In 1856, he was appointed inspector of the United States surveys in California. After completing his job in California, Moody went to Illinois. There, for a time, he was the surveyor of Morgan County. He was in Washington, D. C. when Fort Sumter was fired upon in 1861. One year later, he returned to Oregon. (22)

Information compiled by the General Land Office in 1865, indicated that up to that time no cadastral surveys had been executed in Arizona, Idaho, Montana, North Dakota, Oklahoma, or Wyoming. The surveys that had been done in Colorado were in the vicinity of Denver and Colorado Springs, as a result of the discovery of gold in that area. (85) Surveys in Nevada had been started, (1) and a few surveys had been executed in the Salt Lake City area of Utah, due to the Mormon settlement. The settlers who lived along the Rio Grande prior to the annexation of Texas had required surveys, and that was the only area in New Mexico that had been surveyed. (85)

A fairly large part of California had been surveyed, due to the gold found at Sutter's mill, and also due to the settlement of California's agricultural land by people from the east who had not found gold, but had recognized the value of the land. There had also been a demand for surveys by the people who were living in California before the signing of the Guadalupe-Hidalgo Treaty of 1848.

Only a small portion of the southeastern part of South Dakota had been surveyed by 1865. The western parts of both Kansas and Nebraska were still completely unsurveyed at the end of the Civil War, even though the settlements along the rivers and in the timbered areas of western Oregon and Washington had created the need for surveys there. (85)

In the early 1870's, both Jesse Applegate and Zenas Moody held survey contracts in Oregon.

Jesse Applegate apparently encouraged the younger members of his family to learn something of the skill needed in surveying. In 1870, contract number 137, for the survey of public land in Oregon, was held by deputy surveyors Jesse Applegate and M. L. McCall. Their survey party included: Daniel W. Applegate, compassman; Peter O. Applegate and Edwin Estes, chainmen; William Greenwood, marker; and "Fritz" and Zeke Applegate, assistant markers.

In 1871, deputy surveyor James E. Freeman held a survey contract in Utah. (51) That year, Mr. William H. Odell was the surveyor general of Oregon. In his 1872 report to the Commissioner of the General Land Office, he stated that no one but the men who had surveyed west of the Cascade Mountains could know what such work could be. He noted that "the interminable undergrowth and immense fallen trees make it exceedingly difficult to progress." In spite of this, he also recommended the swift extension of the surveys, due to the value of the timber and agricultural lands in the area. The people were going to settle the land, and had already gone ahead of the surveys in some areas. (51)

Mr. Odell knew about the "interminable undergrowth" from experience. He was a deputy surveyor in Oregon from 1864 until 1871, when he became the surveyor general.

William Holman Odell was called "General" by nearly everyone who knew him, even though he was not a military man. The title was his because of the years in which he was the surveyor general of Oregon. (17)

William H. Odell was born on December 25, 1830. When he was 21 years old he crossed the plains with his father, and spent 3 years helping his family become established on a donation land claim near Dayton, Oregon. William Odell then entered the Oregon Institute (Willamette University) where he studied all the mathematics and surveying available to him, along with his study of the classics. He became a chainman on a government survey party in 1854.

In the late 1870's, he bought the "Oregon Statesman" newspaper in Salem. He was the editor of the paper until 1885. At one time he was the postmaster in Salem.

In 1855, the year after he had his first government survey experience, he married Elizabeth McLench Thurston. She was the widow of Oregon's first territorial delegate to Congress, Samuel R. Thurston, and had taught in several academies, including the Oregon Institute.

In the late 1870's William H. Odell was a member of the Board of Trustees of the oldest institution of higher education in the Far West. It had grown from a small log mission house which was built by Jason Lee in 1834. In 1844, the mission school was taken over by the Oregon Institute which later became Willamette University. (3) The names Oregon Institute and Willamette University were used almost interchangeably for several years. In the 1890's, Mr. Odell became the 4th President of Willamette University's Board of Trustees. He lived a long, productive life, during which he saw some of the early days of both Willamette University and the State of Oregon. Mr. Odell died in March 1922, at the venerable age of 91. (17)

During the early years of the 1870's, surveys which had been delayed by the Civil War were being executed in many areas all across the United States. While the regular work of the cadastral surveyors continued, British and American surveyors were also at work marking the United States-Canada boundary. The line along the 49th parallel westward from the Red River occupied the boundary commission during the 1873-74 survey season. The American boundary surveyors had a fairly large military escort, both cavalry and infantry. The British, however, did not believe that an armed escort was at all necessary. (35)

While American treatment of the plains Indians was not exactly enlightened, the British tended toward over-optimism. Americans reported several Indian raids which their British counterparts failed to mention. (35)

At about this same time, geologists accompanied General Custer's expedition into the Black Hills (South Dakota). They reported that those hills were full of gold. As always seems to be the case, the news got out. The United States started negotiations to purchase the land,

meanwhile attempting to keep gold seekers and settlers out. Prospectors managed to evade the army's efforts to keep them away from the Sioux lands, and in 1875, Deadwood Gulch was the scene of an unbelievably rich gold strike. By the beginning of 1876, it was another gold rush. (26)

Some of the troopers who escorted the boundary surveyors in 1873-74, were among the men who died with Custer (35) at the Little Big Horn in June 1876. It is probable that the first people who benefited from the fact that the international boundary line had been surveyed and marked in that area were Sitting Bull and his warriors. They fled across it in 1877, to escape the pursuing American army. (26)

Incidentally, it was a gold mine in the Black Hills of South Dakota, not one in California, that proved to be the richest one of all. The Homestake Mine started producing gold in 1877. In 1963, it was still producing, and by that year over a half billion dollars had been taken from it. (26)

By the latter years of the 1870's, the surveys in Oregon had long since left the Willamette Valley. By that decade, the valleys of western Oregon were considered an "old" part of the United States. After all, by that time they had been settled for a whole generation. As early as 1871, a newspaper editorial stated that many newcomers were disappointed when they arrived in western Oregon, because they thought they were coming to a new country, but found that it was as old as Kansas or Minnesota. (27)

As the surveys were extended over more of Oregon, other deputy surveyors were hired. Among them were the Fitzhugh brothers, who worked in Curry County. Their names were John and George, and their family was from Missouri. The Fitzhughs moved from Douglas County, Oregon to far more isolated Curry County, in 1872. In 1878, John Fitzhugh held an Oregon public land survey contract. His brother, George, was one of the chainmen on his crew; Isham Cox was the other. James F. Cox was the axeman. There was nothing

in the field notes to indicate the various relationships, but it is known that George Fitzhugh's wife was Sarah Cox before their marriage. (15)

In 1879, John Fitzhugh, wrote a comment about the solar compass which is interesting enough to quote. He said, "The solar compass is a fine instrument in the hands of an astronomer and mathematician. When in perfect order its results are quick and reliable, but under the control of an 'ignoramus' it is the wildest 'machine' that ever was used to trace a line."

The year after that comment was written, Zenas F. Moody became an Oregon State Representative; and by 1882, he had acquired a long beard and a dignified look. That was the year he became the seventh governor of the State of Oregon. His term was, because of a change in the legislative meeting time, the longest single term of any Oregon governor. Governor Moody was a popular governor, and his term of office was a smooth one. (41) Zenas Moody and his wife lived across the street from Oregon's Capitol grounds for many years. He died in Salem, Oregon in 1917. (47)

THE SCANDALOUS YEARS

"Remove not the old landmark; and enter not into the fields of the fatherless:"

Proverbs 23:10

A number of important Congressional acts were passed in the latter half of the 19th century. The Homestead Act, and the Act of July 1, 1862, which authorized grants of public land for railroad rights-of-way have been mentioned.

The Morrill or Land-Grant Act was passed the same year, 1862. It authorized grants of public lands to assist in establishing certain state colleges.

The Homestead Act was liberalized several times in the following years. This was in accordance with the idea that homesteaders would become permanent settlers.

In 1869, the first extensive geological and geographical surveys were authorized. These surveys were of potential mineral lands, particularly within the Rocky Mountain region. They were executed by United States deputy surveyors who held private contracts under the supervision of the General Land Office. Geographical and geological surveys continued in this way for 10 years. At that time the Geological Survey was established as a separate office of the Department of the Interior. (2)

The Mining Law of 1872, opened the valuable mineral deposits in the lands belonging to the United States to prospecting and development. One of the requirements for obtaining a patent to a mining claim was a boundary survey. The survey was to be paid for by the claimant.

Soon, some laws were passed which became important in a different way. The Timber Culture Act of 1873 granted tracts of the public lands to settlers who planted trees on the plains. The Timber Cutting Act of 1878 permitted settlers in Colorado, Nevada, the Territories of Idaho, Montana, Dakota, Wyoming, Utah, and New Mexico to cut timber for agricultural, mining, or domestic purposes on lands that were not subject to entry except for mining. (16) When the Forest Management Act of 1897, with its Forest Lieu Section, was passed careless legislation must have reached some kind of peak.

All of these acts, along with the Preemption and liberalized Homestead Acts, were passed to help the settlers. Many of the people who backed some of these laws, such as Senator Henry Moore Teller of Colorado, did so in good faith. Unfortunately, by the time they actually passed they were full of so many handy loopholes that they almost invited fraud (16). Fraudulent use, speculative abuse, and the exploitation of vast natural resources on the public lands for private gain, was their ultimate result.

The first National Forest Reserve, called the Yellowstone Park Timberland Reserve, was established under the Act of June 4, 1897. It was to be surveyed, protected, and managed by the General Land Office. (1) The General Land Office was really prepared to handle only one part of the job, the surveys. Binger Hermann, then Commissioner of the General Land Office, apparently realized the limitations caused by this fact. In October 1898, he expressed his concern about the forest lieu portion of the Forest Management Act. Any owner or claimant to land within the reserves was allowed to give up that tract and select vacant land in its place. The major beneficiaries of this Act were the Santa Fe, the

Northern Pacific, and the Southern Pacific Railroads. Through the purchase of lieu scrip from the railroads, the C. A. Smith Timber Company and the Weyerhaeuser companies acquired valuable lands. The railroads, in many cases, exchanged lands fit only for grazing for lieu scrip. This they then sold to the timber companies, and the huge timber companies exchanged the scrip for extremely valuable timber holdings. (16)

In October 1898, Binger Hermann warned that the forest lieu land selections were being misused. He was afraid that the open exchange of grazing land, or land that had already been logged, for valuable timber land would lead to pressure from the people who were actually making money from this law, for the creation of more land reserves with more lieu land scrip. Six months after he had expressed this fear, Mount Rainier National Park was created, and the Northern Pacific Railroad was given the right to exchange its valueless, rock and brush land on the side of the mountain for surveyed and unsurveyed lands outside the National Park. (16)

Many years before Binger Hermann tried to inform Congress of the misuses inherent in some of the public land laws, other people also pointed out abuses under various acts.

In his 1880 report to the Commissioner of the General Land Office, John Wasson, the surveyor general of Arizona, seconded the conservation and resource management ideas of the Public Land Commission which was authorized by Congress in 1879. The Land Commission had collected information and made recommendations to be used in disposing of the public lands in the western part of the United States to actual settlers.

Mr. Wasson's report stated: "It is mere bosh to orate about our vast unsettled and uncultivated domain which cannot be populated to any great extent under present legislation; and it is a cruel wrong to the poor to induce them to go upon....[non-irrigable land valuable only in large tracts for pasturage] to make homes." He recommended that, "All the irri-

gable agricultural....lands....be immediately surveyed into townships and offered for sale in large tracts....with the imperative condition of providing water....,as the case may require...".

He spoke in plain and simple language about the San Carlos Indian Reservation too, and called attention to the fact that its boundaries were, as yet, not surveyed. This circumstance he felt to be unfortunate in the extreme since it discouraged and embarrassed legitimate mining enterprises on and near to its western border, and also caused mischief to be done by "men and officers whose greed overcomes their sense of duty." He called the operations of the mines in that area "disgraceful, though possibly....useful....by reason of the exposure of the bad acts of high but unfaithful officers...." He went on to say that "in the interest of the Indians, miners, and settlers...., as well as government (and perchance of officials whose power to resist temptation is insufficient), the lines of that reservation should be established on the ground so that none but blind people could plead ignorance of its exact locality." (52)

Mining was also important in other areas, but there were apparently enough surveyors available to help prevent claim disputes and abuses of the mining laws in some States. Albert Johnson, the surveyor general of Colorado commented in 1880 that the part of his report giving the names of the deputy surveyors was of interest "chiefly...from the fact that there are so many of them." The vast majority of them were mineral surveyors, so he went on to say that, "claimants can make no just complaint of the scarcity of surveyors, as there are large numbers in every mining camp... It seems as if surveyors especially had heeded the admonition of the...sage [Horace Greeley], whose advice was, 'Go West, young man.'" (52)

As far as the reservation of public lands is concerned, it was originally a high-minded effort to preserve certain areas for the people of the United States. In the early years of the westward migration, the land of the United States seemed so vast as to be almost limitless.

That is why the provision, under the Ordinance of May 20, 1785, which set aside land in each township for the support of public schools was so remarkable.

In the early 1800's, townships in Indiana which contained salt springs were reserved, and four sections surrounding the Hot Springs in Arkansas Territory were "reserved for the future disposal of the United States" by section 3 of the Act of April 20, 1832.

The survey of the public lands did not reach the area of the Hot Springs until early in 1838, and at that time the south half of both sec. 28 and sec. 29, all of both sec. 32 and sec. 33, in T. 2 S., R. 19 W.; and the north half of both sec. 4 and sec. 5, in T. 3 S., R. 19 W., were reserved. (52) Gradually, other public lands that were of great natural beauty, or that were in some way unique, were set aside.

In 1864, the "Gorge" and headwaters of the Merced River "known as the Yo-Semite Valley" and the "Mariposa Big Tree Grove" of giant sequoias were given to the State of California to be held for all time for "public use, resort, and recreation." (16)

In 1872, some 2 million acres on the Upper Yellowstone River, near the junction of the boundaries of Idaho, Montana, and Wyoming, were set aside and dedicated "as a public park or pleasuring ground for the benefit and enjoyment of the people." The national park created 3 years later on Mackinac Island in Michigan did not survive, but in 1890, legislation set aside lands in California which became Sequoia, General Grant (later part of Kings Canyon) and Yosemite National Parks. Prior to 1900, as an outgrowth of this legislation, Mount Rainier National Park in Washington was also created.

The state park in Yosemite Valley was eventually ceded back to the United States. It became a part of Yosemite National Park in 1906. (16) As years passed, other tracts of public land were withdrawn and dedicated as National Parks, National Monuments, Wildlife Sanctuaries, and National Forest Reserves. The boundaries of these areas were run and marked by cadastral surveyors.

More of the speculation and fraud possible under certain laws was pointed out by the Commissioner of the General Land Office in his 1890 report: "The Act of June 3, 1878, providing for the sale of [timber and stone] lands in California, Oregon, Nevada, and Washington should be repealed. I have found....that while it provides for entries of not more than 160 acres in all, for the sole use and benefit of the entryman...it has been made the vehicle of speculative and fraudulent appropriation from the beginning...and has caused the destruction of the forests where most needed [to protect the watersheds]." (53)

It is interesting to note that the Timber and Stone Act of June 3, 1878 was eventually repealed, as suggested in 1890. It was repealed in 1955! (1)

In the 1880's, examiners of surveys under the General Land Office brought to light evidence of fraudulent entry upon the public lands, and fraudulent surveys of those lands. A large scale investigation followed. The annual reports of the General Land Office for the years of those investigations show that the frauds eventually involved many people in positions of trust. Deputy surveyors were not immune from the temptations offered to them. Fraudulent surveys existed in plenty, but they should not be accepted as the general rule or granted too much significance. For the most part, all through the years, the surveys of the public lands have been executed with care and honesty. Before the era of scandals in Oregon and California, and in other Western States, had ended, cases which involved a Senator and a Congressman among others, (16) were exposed. The California frauds were the worst on record, and the Benson Syndicate cases are probably the most infamous examples of fraudulent surveys. Actually, they were a lot more than that.

There were cases of fictitious contract holders, false witnesses, phoney field notes, fake oaths, and fraudulent payment of drafts on the United States Treasury. Those involved in the Benson Syndicate activities included employees in the office of the surveyor general,

and deputy surveyors, both real and fictitious, bankers, and John A. Benson, himself. The syndicate operated in California and other Western States mainly in the 1870's and 1880's. A great many contracts and a few hundred thousand dollars were involved.

The Benson fraud cases were closed in 1898. (32)

During the years after the passage of the Forest Management Act, as Binger Hermann quietly tried to point out defects in the laws, Gifford Pinchot, of the Department of Agriculture, spoke widely and well on the subject of conservation. It is interesting to note that it was during the period of great conservation activity that some of the most flagrant frauds and abuses concerning the resources of the public lands took place. Perhaps one led to the other, and the frauds had some value in that, once exposed, they eventually led to conservation.

In 1905, the administration of the reserved forest lands was transferred to the Department of Agriculture. The General Land Office retained the responsibilities of surveying mining claims and administering the mining and land laws within the areas now called National Forests. (1)

During the scandalous years, many ordinary, honest surveys were going on as usual. In 1880, the surveyor general of Utah reported that there had been a good bit of trouble in Utah Territory because of the loss or destruction of the public survey corners established in certain localities during the 1850's. The surveyor general wrote that, according to his information, the principal reason behind the destruction of the markers was the fact that the Mormons, having been instructed by the Church to do so, plowed up and destroyed all the corners and had their land run off into 5 and 10 acre lots. (52)

The public land in the central part of Indian Territory (Oklahoma) was opened to homesteaders on April 22, 1889. (1) Thousands of settlers took part in a thundering stampede for choice land in the new area. In the years that

followed, other "runs" occurred as treaties were negotiated, and Indians took allotments for their reservations. These land "runs" were filled with drama and excitement, and have become a well known part of American history. Less well known is the fact that all these areas were surveyed before they were opened for settlement.

The Oklahoma Lands, the Cherokee Strip, and the Cherokee Outlet, are names that evoke mental pictures of restless horses and wagons in lines reaching to the horizon; and crowds of people, more than three times as many as there were homesteads to claim, (77) all hoping to share in the wonderful American dream, the ownership of land. Each time the noon signal sounded, thousands upon thousands of people rushed wildly into the unreserved area to stake their claims in surveyed townships. (1)

During these years, surveyors had the usual number of problems, and some of the problems were not usual at all. For example, in November 1889, a Douglas County, Oregon deputy surveyor, William Thiel, filed an affidavit with his request to be relieved of "...further obligation under Contract No. 534." He described an accident which had befallen him in August: "...was obliged to climb over a large tree on a steep hillside...that same being very slippery from a rain..., caused a sudden slip, by which my hernia was further extended, causing my bowels to escape, unless I kept my hand on the orifice, which is impossible to do in climbing over logs or trees." (44)

As if all the other problems, including illness and injuries, were not enough, early surveyors also had their share of red tape to untangle.

On March 19, 1889, deputy surveyor Thomas S. Wilkes wrote to Mr. Douglas W. Taylor, then surveyor general of Oregon, about his field notes. He told Mr. Douglas that he, Mr. Wilkes, possessed patience "...of vast extent, and I'll keep sticking on my autograph as long as it lasts and....hope to get the notes written up inside of the period of my natural life so that they suit the fastidiousness of the General Land Office and fill all their red

tape requirements." (44)

The original surveys of the strange and beautiful Florida Everglades were, for the most part, executed in the 1870's and 1880's. Recently part of this wilderness was resurveyed, and it was found that some conditions had not changed much in nearly 100 years. The dense undergrowth and cypress trees described by the original surveyors were still in evidence. The muck and water, the scorpions and insects, and the cotton mouth (water moccasin) snakes were also much as the old field notes described them. (91)

Haste in completing a survey might be understood in some of the circumstances encountered by those early surveyors. In one instance, a surveyor named Solee concluded his field note record of his survey in this way: "Water 30 inches deep, insects fierce, snakes all around. Twenty to 30 alligators ahead of me. End of survey." (91)

Problems regarding private claims were still going on. The surveyor general of New Mexico wrote in July 1890 to explain a part of the reason behind the problems. He related the problem to its beginnings at about the time of the discovery of New Mexico when Emperor Charles V of Germany (who was also the King of Spain) decreed as follows: "If in that which is already discovered in the Indies there should be any places and districts so good that it may be proper to found settlements, and any person should make application to settle and reside in them, in order that with a greater will and profit they may do so, the viceroys and presidents may give them in our name lands, house lots, and waters in conformity with the disposition of the land."

The surveyor general went on to report that, "This plan was pursued until the annexation of the territory by the United States. Under the Republic of Mexico the colonization laws and regulations became a....complete system,.... adapted to the....people....and to the.... country to be occupied." After explaining the differences in the systems he stated that the remedy for the problems would be surveys,

because, "Certain title to the land is the foundation to all values. Enterprise in this Territory is greatly retarded because that foundation is so often found lacking." (53)

At about this same time, the 1890's, Felix Salazar, from Chimayo, New Mexico, was employed as flagman on surveys in that area. Later, when he was an older man, he told of the method he used in those years. He said that he "flagged with a 30-30 and the fastest horse he could find." (61)

In the early 1900's, C. H. Sinclair surveyed the oblique boundary line between California and Nevada. It was an area which required that much of the work be done by horseback or on foot. (106)

Sinclair hired Death Valley Scotty, then about 13 years old, as water boy and wrangler. During the survey, Scotty got his first look at Death Valley.

As Sinclair and Scotty climbed one of the mountains they stopped to rest. Below them was a small, isolated, perfect gem of a green valley. All around were the twisted mountains and geologic forms which were beyond description in their splendor. Sinclair looked out over it all and dreamed aloud, "When I retire and build my castle, there is where it is going to be."

Death Valley Scotty told the story many times. He always said that although Sinclair did not get to build his castle, "I built one there for him." (106)

Independent resurveys were made in Wyoming in the first few years of the 1900's. (57) An entirely new set of section lines was run over land originally surveyed in the 1880's, because some of the surveys had proven either erroneous or fraudulent. Private land and valid claims were run out in accordance with corners of the original survey as far as was possible, that is, where the corners could be found. The private land claims were given tract numbers beginning with number 37 in each township. Any of the old corners of the former survey that were found were destroyed. Some of them were not found and stayed on the ground causing

confusion. These independent resurveys were made according to special instructions issued or approved by W. T. Paine, Chief of Division "E" of the United States General Land Office. Under these instructions, closing corners were set on the independent resurvey lines where they entered and left private lands. Some of these independent resurveys were executed by W. R. Bandy, who will appear again later on in these pages. Mr. Bandy has stated that he believes that the last of these independent resurveys in Wyoming was executed about 1910.

Since certain lands had been reserved for various reasons, the boundaries of the reserved lands were also run and marked during this period.

In the early autumn of 1908, deputy surveyor William B. Douglass started on his way to survey the White Canyon Natural Bridges in the southeastern part of Utah. Along the way, the existence of large prehistoric ruins in the Navajo Indian Reservation in Arizona, was reported to him. He passed the information along to the General Land Office on September 11, 1908. He recommended that they be located and inspected with a view to their preservation. (83)

Douglass had a Paiute Indian, then called "Mike's Boy", but later known as Jim, working as axeman on his survey party. Mike's Boy told Douglass of a great rainbow-arched natural bridge that was located "near the Navajo Mountain." This was reported to the General Land Office on October 7, 1908.

About 2 weeks later, the Commissioner of the General Land Office sent instructions to Douglass regarding the investigation of the reported bridge. He was, if he found it worthy, to segregate it.

The snow that fell in the winter of 1908-1909 made it impossible to carry out the Commissioner's instructions immediately. While he waited for better weather, Douglass made more inquiries, but he learned nothing more of the bridge. Some people even said they thought Jim might not be telling the truth about it. However, the location of the ruins was estab-

lished. They were designated a National Monument by Presidential Proclamation on March 20, 1909.

Later that year Douglass was again instructed to seek out the reported bridge, and to segregate it if he thought it to be of sufficient interest to become a national monument.

He left Bluff, Utah, in early August 1909, to search out the bridge. His party consisted of John R. English and Jean F. Rogerson, chainmen; Daniel Perkins, flagman and packer; and John Keenan, flagman. Jim (Mike's Boy) was their guide.

When the survey party reached Oljato, Utah, they met other bridge hunters, a professor and three students. The two parties continued together. Later, another guide was hired. He was also a Paiute Indian, and was more familiar with the area than Jim was.

Masja Begay, the other guide, took them along crude Indian trails. In some places the survey party had to widen and improve the trails for the horses. Soon the horses could not continue with full packs, and the survey party was forced to leave all but a bare minimum of provisions behind.

Jim and Masja Begay led them truly. They reached the bridge on the morning of August 14, 1909. Douglass, the chainmen and the flagmen were the only ones in the combined party who actually reached the top of the graceful natural bridge. It arches, rainbow-like across a span of 278 feet. It stands 309 feet above the little stream which winds through the deep and jagged gorge beneath it. Rainbow Bridge is only 33 feet wide, and the arch is just 42 feet thick. It is located 4 miles northwest of the towering Navajo Mountain. It is N. 60° 25' W., 7 miles, 65.87 chains from milepost 179 of the Utah-Arizona boundary line.

The survey to segregate the area took so long that Douglass and his party ran out of provisions. They had a hungry trip back to the area where they had partially unloaded the pack horses, but they made it. (83) Due to their efforts, Rainbow Bridge was preserved as a National Monument.

The boundaries of Mt. McKinley National Park were also run and marked by cadastral surveyors. The need for the surveys came about after 2 million acres, surrounding the highest mountain peak in all of North America, were set aside as a national park in 1917, by order of President Woodrow Wilson. The southern boundary of Mt. McKinley National Park was surveyed by a large party, including Leonard M. Berlin and Floyd Betts, during a summer season in the early 1930's. The boundaries on the north and west were a different matter. The tundra, muskeg flats, and swift-flowing, unbridged rivers along those borders made winter ice a necessity for overland travel. To the men who had been on the earlier survey, ice sounded preferable to mosquitos anyway. (80)

Leonard M. Berlin and Floyd Betts volunteered for the job. As they studied the applications submitted by veterans of prior North-country surveys, they looked for men who were able to handle snowshoes and a challenge that was more than physical. They needed men who could take care of both themselves and emergencies. There was no budget provision for a cook or a medic, or even a camp roustabout. The men themselves had to be able to play all the roles.

Ken Nelson was the first man chosen, partly because of his good humor and unsinkable morale. Larry Dauphany was a very different type, but just as valuable to have along. He was conscientious almost to the point of grimness, and he seldom opened his mouth, preferring to use his hands instead.

Ken shared a tent with Larry, and once said that it was 6 weeks before he actually heard him speak. The words Larry said were memorable in the extreme. Said he, "The river's still going by."

Herbert C. Torgerson had been on many a survey, and was their choice as head chainman. He was a competent, muscular sourdough with almost legendary endurance. W. C. Conover was his assistant. He was known as a good chainman, and besides that, he had a mighty good aim with an ax.

Grant Pearson was loaned to the survey party

by the National Park Service. He was familiar with the region, and later became Superintendent of Mount McKinley National Park.

Floyd Betts was, at that time, considered the Dean of Alaskan surveyors. He had been surveying longer than any of the others. (80) Leonard Berlin gave him credit for teaching them more of the practical side of surveying in the far north than they could ever have learned from books. Leonard put it all to good use later as a member of Admiral Byrd's 1939 expedition to Antarctica. Later still, Leonard M. Berlin became Area Cadastral Engineer in Portland, Oregon, and State Engineering Officer in California. It has been said that he knew men, and was a fine administrator. (70)

All of the supplies and gear these seven men took with them had to be transported by dog sled. The concrete-filled iron posts that were used for markers on the survey weighed over three-quarters of a ton, and that alone limited the remainder of the supplies they were able to carry. Each man took one change of clothes, the best and warmest available. The snowshoes were also the best ones made, in spite of a limited mid-thirties budget. Food was another matter. They had planned that there would be plenty of game for meat, but in all the time they were out on the survey they did not see so much as one rabbit. Their dinner menus were, therefore, limited to beans, dehydrated potatoes, dried apples, rice pudding, coffee, cocoa, and the baking powder biscuits which were usually made by Floyd. He alone seemed to acquire the knack of using his hand for a measuring cup, and the upper part of the flour sack for a mixing bowl. (80)

All the other cooking duties were rotated. No one person wanted to cook breakfast on a permanent basis, because the first part of that job was the starting of the fire. There was something about the cold, weird quiet of an early morning, on the side of a winter-time Alaskan mountain, that was not conducive to volunteers.

The surveyors developed a system that was pretty good for getting the work done, but it did not allow time for enjoying the spectacular

views of the mountains, lakes, and northern lights. They had a seven-day work week, and were, by turns, scouts, solar observers, chain gang, and diggers of post holes.

That last named duty was a rough one. Each post weighed 16 pounds, and each one had to be buried an authentic 28 inches into the frozen earth. Of course, the snow had to be cleared away before they reached the ground at all, and this gave rise to the invention of altogether new invective. Even quiet Larry was heard to utter an unseemly word or two while planting boundary posts.

After snowshoeing across open spaces, setting posts every single mile, slashing a 10-foot passage through tall trees, when the line crossed timbered country, and piling up rock cairns nearly 6 feet high on all the high points of the barren areas, the surveyors felt a justifiable pride when they looked back over their line and saw the miles they had marked through the icy land. To celebrate the distance covered, they put up a sign, "National Park Boundary." Ken Nelson added another line, "If you've come this far, Brother, you may as well go on in."

On the last day of the survey Leonard Berlin was operating the instrument, and Ken and Floyd were about a mile ahead of him. They had the only rifle in the party. Leonard could see them, but they were too far away to assist when he heard wild and threatening noises close to his position.

Leonard had cut enough timber that season so that he felt pretty secure with a double-bitted ax in his hands. He moved to the opening of a nearby cave where the noise seemed to originate. Four wolves came out in single file. As they emerged from the cave, he gave his ax arm a little more practice, and soon, four wolves lay dead at his feet.

Since there was a bounty on wolves, at that time, Leonard skinned them, leaving the leg bones attached as required for bounty collection. He earned eighty depression dollars, almost a whole months pay, from that few

minutes with his ax.

They completed the survey 5 days ahead of schedule, at the cost that had been estimated, and went to Fairbanks. Once there, they rented rooms in a hotel, and Larry made an announcement. He said, "I've rented this bathroom, I'm going to get my money's worth." He then took a bath. Then he took another, and another. He must have been the cleanest surveyor in Alaska because the men swore that Larry took a total of seven baths in that one day. (80)

Montana, U.S. Surveyor-General's office clerks about 1909. (63)

Around the campfire in 1902 Yellowstone National Park. Frank M. Johnson, examiner of surveys is standing at the left.

Richard E. (Elmer) Bandy, who joined the Brunt survey party in the early 1900's. (57)

Standing left to right: Grant Dawson, Colonel Samuel W. Brunt, Arthur Brunt.

Seated left to right: Sam Dawson on Mrs. Dawson's lap, Mrs. Brunt, Mrs. Arthur Brunt and son Bill. Photo taken near Meeteetsee, Wyoming. (57)

Colonel Samuel W. Brunt in camp in McCullough Peaks, east of Cody, Wyoming, 1905. (57)

Surveyors pause for lunch on moving day. Note mess-box and sibley stoves on wagon, and horse at far left eating from nose-bag. Man at left is Sam Hutton, fourth and fifth from left are R. E. (Elmer) Bandy and his wife, Lula. Second from right is Arthur Brunt. Photograph taken at Sunlight Basin, Wyoming, in 1907. (57)

Hopi Indian Reservation, Arizona, 1910. Left to right: Van and T.Y. (called Ty) White. The instrument is a Gurley with a Burt Solar Attachment.

Right: Survey camp, Garland, Wyoming, June 1905. Standing left to right: Luther Glasgow; "Kentuck" Friday, W. R. (Roy) Bandy, Miss Jones, Wilford Utterbach (party chief), unidentified, Ernest Strong. Peeking at left: Troy Troutman. Seated left to right: Miss Huber, Sam Hutton, and Rhoda Huber (camp cook). (57)

Glen F. Sawyer's survey crew, Missouri River Breaks. Note pack horse at left carrying tools and iron posts. (57)

Above: W. R. Bandy's survey camp on the move, Montana, 1921. Note two up-to-date vehicles, as well as teams and wagons. (57)

Guy P. Harrington's outfit hauling water to a side camp during Dunnington survey which was started November 8, 1911. T.4N., R.20W., Arizona.

Mess wagon on the move in eastern Montana, 1915. (57)

Wyoming, 1911. Inez Bandy is holding a 3-foot rattlesnake she killed. (57)

Glen F. Sawyer, Missouri River Breaks south of the Bear Paw Mountains, 1918. (57)

LEFT: Survey camp on the move. Note the lanterns on the side of the wagon, the tub lashed to the back of the rig, the benches (packed one up and one down), and what appear to be army-style leggings worn by the man at the right.

RIGHT: Early day cadastral survey camp in the Black Hills of South Dakota.

United States public land survey, Devil's Canyon in the Black Hills of South Dakota. The year is about 1914.

1/4 corner between sections 8 and 9, T.41N., R.3W., California. William E. Heister's survey party, August 1927.

"Breakfast in the Big Horns."
Photograph from an oil painting
by Montana artist Shorty Shope.
It was painted from a photograph
taken on an August morning in 1912.

Left to right: Willis Bandy, Roy Bandy,
Inez Bandy, and chainmen George
Horner and Howard Pitt. (57)

Noon hour for some General
Land Office surveyors near
Sibring, Florida in 1918.
Hal D. Craig is under the transit.

Wash day on a Sunday in September 1914. The survey camp is in Fergus County, Montana. (57)

Suppertime in a 1917 survey camp in the mountains of Washington State. C. W. Blocker is at the right; Quintin Campbell is third from the right.

One of the phrases BLM cadastral surveyors hear often is, "Don't drop the transit." Following that rule is difficult at times. Just getting to the next corner sometimes presents a problem.

LEFT: The year, place and surveyors are unidentified, but the situation is familiar.
ABOVE: 1914, in the State of Washington.

In 1914 the surveyors called this "typical mountain work in the West." The mountains are in Washington State. The instrument is a solar compass with a telescopic attachment.

Setting up camp in the desert. Arizona, 1916.

H. S. Werschkul,
rear chainman,
Group 33, Oregon, 1917.

Chainman on line. Group 33, Oregon.
L. V. Hoffman, head chainman at right.
H. S. Werschkul, rear chainman at left. 1917.

Missouri River Breaks, 1918. Art Stensland
at the transit. (57)

W. R. Bandy's survey camp in the Missouri River Breaks south of the Bear Paw Mountains, 1918. Note home-made water tank (center). They had to haul water 15 miles. Also note use of both wagons and cars. (57)

Interior of cook tent, GLO survey camp near Wilson, Arkansas, November 1915.

Note the kerosene lamp and the fact that the cook has just served William Hiester (partly out of picture at left) a nice big piece of pie.

A cadastral surveyor looks at the rough terrain in northern Idaho. Priest Lake, 1911.

A survey party at work in heavy timber in the area near Gypsum, Colorado. Hans Voigt is fifth from left; John S. Knowles is at the extreme right, circa 1925.

United States cadastral surveyors in southern Wyoming. The year is not known, but is probably in the late 1920's or early 1930's. The horse was used for carrying iron posts, tools and lunches.

Moving camp in 1914 Flatwillow Creek, Fergus County, Montana. Inez Bandy is riding the horse. (57)

LEFT: Portrait of a surveyor. This one, taken in Arizona in 1917, is of Quintin (Jerry) Campbell.

ABOVE: Left to right: Ernest Rands, District Engineer or Assistant Supervisor of Surveys; Clay Tallman, Commissioner of the General Land Office; Frank M. Johnson, Supervisor of Surveys, circa 1914.

LEFT: A beautiful site for a survey camp. T.24N., R.13 or 14E., Willamette Meridian, Washington State, 1914. Probably Cathedral Rock in the background.

RIGHT: Four feet of snow in September 1912, in the Big Horn Mountains, Wyoming. Second from left is Inez Bandy, standing beside the square "office tent." (57)

Moving camp in what is sometimes called "the good old days," January 1915, Group 41, Arizona.

Rare 3-mule wagon outfit moving camp. T.5N., R.TE., San Bernardino Meridian, California March 1920. Group no. 62. Quintin Campbell, U.S. Surveyor.

SURVEYS AND SURVEYORS

"And he measured the wall thereof, an hundred and forty and four cubits, according to the measure of a man, that is, of the angel."

Revelation 21:17

The boundaries of most of the states west of the Mississippi River, and a number of the central and southern states, were surveyed under the direction of the General Land Office. Many resurveys or retracements of parts of these boundary lines have been made in the course of the regular cadastral surveys of the public lands. Sometimes several surveyors, over a period of years, had a part in establishing or marking these boundaries.

In one unique case, the first line involved was the survey of the southern boundary of Colorado from the southeast corner of the State westward to the 103rd Meridian. It was surveyed by Macomb, in 1858-59. The same portion of the south boundary of Colorado was resurveyed by deputy surveyor John G. Majors, who along with Daniel G. Majors, was responsible for several state boundary surveys. John G. Majors also surveyed the part of the east boundary of New Mexico which lies between the northwest corner of Texas and the 37th parallel of north latitude. These surveys were approved by the

Commissioner of the General Land Office on July 29, 1874. Daniel G. and John G. Majors were probably brothers. There appears to be no documentation of their relationship, but the records show that they sometimes worked together; and both surveyed during about the same period of time, the late 1860's and the 1870's. (37)

The New Mexico-Colorado boundary from the 103rd Meridian westward was surveyed by United States surveyor E. N. Darling. He was to survey along the 37th parallel, but later investigation showed gross errors existed in the line in the area near Edith, Colorado.

In 1902-03, H. B. Carpenter resurveyed the entire line dividing the State of Colorado from the Territories of New Mexico and Oklahoma. His line differed from Darling's, which caused a boundary dispute. The United States Supreme Court, in an opinion dated January 26, 1925, stated that Darling's line was the correct one in spite of its errors, and regardless of the temporary General Land Office use of Carpenter's line. The Carpenter line was not used after that time for public land surveys. In 1917, the portion of Darling's line between mileposts 202 and 241 had been rerun by W. C. Perkins of the General Land Office. Perkins' line was monumented with iron posts, and it was accepted by the court.

Mr. Arthur D. Kidder of the General Land Office was appointed by the court as commissioner to resurvey Darling's line. The field work was done under his supervision, but the execution of the survey was retarded due to delays in the receipt of funds from the States involved. After Mr. Kidder's death in 1958, a new commissioner, Joseph C. Thoma, was appointed. It was he who prepared the final report which was approved by the Supreme Court on October 24, 1960.

Monuments set in 1859 by Macomb, and in 1900, by Levi S. Preston in a resurvey of Major's line 2-1/2 miles eastward to the northeast corner of New Mexico, were to be the controlling points in the survey, according to instructions of the court.

The survey under Mr. Kidder began at the Macomb monument, which he replaced with a concrete post bearing a bronze tablet. The line then ran east to the Preston monument; then west, reestablishing Darling's survey. This resurvey was controlled by the monuments established by Darling that were recovered. Bronze-tableted, concrete mileposts were set on the line between the original mileposts. Perkins' iron posts were reset in concrete in their original positions. The Carpenter monuments that were known to have been used as points of reference for local surveys were preserved, but the boundary marker identification was removed from them. All the other Carpenter monuments were destroyed.

The closing point on the west end of the line was a point set by United States surveyor C. Robbins as he surveyed the Arizona-New Mexico line in 1875. This line is on a meridian determined by reference to a landmark peak called "The Needles" by the Wheeler Survey of 1874. Robbins called it "the southwest needle point of Wilson's Peak." The boundary line was run west and north to the point where the 32nd Meridian west of Washington intersects the south boundary of Colorado. The point established by Robbins was 1 mile 45 chains east of the mark which had been established by Darling in 1868, as the southwest corner of Colorado. Robbins' point was accepted, and became the only monument in the United States marking the common corner of four States. From this point the west boundary of Colorado was surveyed in 1879. The Utah-Arizona boundary, which intersected Robbins' point, was run in 1901.

In 1899, the original sandstone marker was found damaged. It was replaced that year by Page and Lutz. In 1931, Everett H. Kimmell replaced the Page and Lutz stone with the present concrete monument. The Department of the Interior placed a 28-foot square concrete paving block around the monument in 1962. It is oriented in the cardinal directions, with the names and seals of four States appearing in their correct quadrants. (37) The States that share this unique monument are Colorado,

New Mexico, Utah, and Arizona.

Everett Kimmell was one of many men who followed a family tradition in becoming a surveyor. His father and at least two of his uncles were also cadastral surveyors. Down through the years one finds the repeated incidence of boys who admired older members of their families who were surveyors so much that they paid them the extraordinary compliment of wanting to be like them.

Even in early 18th century Colonial America, surveyor Nathaniel Dwight inspired his son, Timothy, to follow in his footsteps, and in the latter half of that century, both John Jenkins, Sr. and his son, John, Jr., surveyed in the Wyoming Valley of Pennsylvania. These, and several other examples are included in the preceding pages.

During the summer of the year he replaced the marker for the "Four Corners", Everett H. Kimmell, called Kim by his associates, and Jess Gassman, Paul Spencer, a cook named "Doc" and another young surveyor, moved their survey camp to the Navajo Indian Reservation just south of Aztec, New Mexico. While the crew set up the camp off to the side of an Indian trader's post, Kim went over and talked to the trader. He explained that the surveyors were going to resurvey that township, and asked the trader if he knew the location of one of the old corners in the area. The trader did not know, but there was a Navajo Indian in the store who was an old man. The trader asked him if he knew where the surveyors had set corners many years before. The Navajo man said that he did know of one, a rock with marks on it. He agreed to show it to Kim the next morning. (61)

The next morning the surveyors were up bright and early. They ate their breakfast and were ready to go, since the prospect of being led to one of the original corners was much nicer then the thought of hunting for it. They waited, and still the Indian man did not come. They stood around and talked and watched and waited. Still no Indian man. Finally, a little after 9 o'clock, the young surveyor

looked out across the sagebrush and saw a man walking along, leading a horse. Kim was about ready to start out to see if he could find the corner without help, but he decided to see if this was the man they had been waiting for.

As the man approached, Kim saw that it was the old Navajo man. He walked into camp, and there, tied carefully on his horse's back, was the rock corner, which he had brought to show Kim, just as he had said he would!

Naturally, Kim was a bit upset. Later, through the trader, he was able to explain to the Navajo man that they needed to know the location of the spot where he had dug the stone out of the ground. The old man took them to the place. It was a quarter corner, so they could not tell which way the quarter had been set, since it had been removed. They started out and at first went the wrong direction. After they had gone a mile and found no corner, they turned around and ran the other direction. This time they started finding corners.

After a hard day's work, they were glad to get back to the supper "Doc" had ready and waiting for them. Incidentally, camp cooks were often interesting types, and Doc was certainly no exception. He was well educated and had been ordained a minister, but he decided that was not the life for him. He became a cook in the survey camps. He was a pretty good cook from all reports, except when he developed an overpowering thirst.

In the fall of 1931, Everett Kimmell's survey crew was in Gallup, New Mexico. One day Jess, Paul and Doc went to town. It was during the local Indian Ceremonial Celebration, and Doc's thirst got the better of him. Jess and Paul went off and left him, so he was late getting back to the house the crew had rented. There were a lot of steps coming up to the house, and Doc made the trip on all fours. He crawled across the porch toward the door. Kim and another fellow were sitting on either side of the door, so they heard the thud distinctly when Doc missed the doorway and banged his head on the casing. They also heard him say, "Whoa, Doc. Back up and try it over."

He took his own advice, and finally made it inside the house and to his room. Doc carefully wound and set his alarm clock. He put it in the dishpan, and put it under his bed so it would wake him up on time the next morning. It did. That old-fashioned, loud, alarm clock, dancing in the tin dishpan while Doc banged around trying to get under the bed to shut it off, made an unearthly racket, as anyone in the house that morning could testify. (61)

There is a story about another cook in a survey camp in Montana or Wyoming. The cook had complained long and often about the battered old stove he had to cook on. He finally convinced the party chief, reported to have been one of the Bandy brothers, that a new stove was in order. When they set up camp in the mountains that season a new cook stove occupied one corner of the cook tent. They started work on the line they were running, and during the first day or two, they saw signs of a bear in the area. One of the surveyors asked the cook what he would do if a bear wandered into camp when the surveyors were away. The cook showed him a gun he had tucked away, and told the surveyor that he was not worried about bears or any other wild animals.

One very early morning, before daylight, a bear actually did come into camp. There was a lot of yelling; and the cook jumped up out of his bed, grabbed his gun, and shot at the hulking black shadow looming up inside the cook tent. At the sound of the shots, the surveyors rushed in to see if the cook was all right. He was fine, but his brand new stove was full of holes! (63)

Everett Kimmell worked at about the same time as Wendell Hall, whose father was also a surveyor. A cadastral engineer who worked with Wendell Hall as an associate party chief in 1933, has reported that he, "tied into a lot of work done by both Wendell and his father, and never disagreed with their azimuths by more than about a minute." In his opinion, they both did precise and careful work. (61)

Brothers, Van and Ty White, worked in Arizona about 1912. Ty also worked in California. At

a later time, Wendell Hall and Ty White both surveyed in the Dakotas. The Saxons, the Pidgeons and Hans Voigt and his younger brother, Emil, were some of the other surveyors of that time who were family surveying teams, as were William Hiester and his younger brother, Tom. They worked mainly in southern Utah and Arizona. Hans and Emil Voigt were both surveyors for many years. They were German, and had recognizably German accents. Some of the other surveyors liked to listen to Emil Voigt get angry, because in the heat of anger his accent got in the way of his swearing, and he would get his plurals mixed up. For example, he would say, "...sons of a b..." when he was talking about just one "son"! (57) Emil smoked a pipe, one of the curved-stem kind. The thing that made it memorable though was not its shape, but its strength. (70) Emil worked for several years in Nevada. Hans surveyed mainly in Colorado and died about 1936. (67)

William B. Kimmell and William Hiester both worked in Oregon in the 1920's, as did Joe Ganong, George F. Rigby, and Willis Bandy. Joe Ganong was born just before the "Gay Nineties", and started his career as a United States cadastral surveyor in 1912. He earned a reputation as "one of the best", and was for many years Area Cadastral Engineer in Portland, Oregon. It has been said more than once that, "He was a man who might take a day or two to answer a question on cadastral surveying, but when he did give the answer, you could depend on it being right." (60)

William B. Kimmell and his younger brothers, A. (for Albinus) N. and A. C. (called "Tony") also worked in Idaho. A. N. Kimmell was Everett's father. (67)

Ernest Parker did a lot of surveying in Montana. His brother, Horace, worked mainly in Utah. Kansas-born Tom and Hugh Crawford, also brothers, worked in many areas. Hugh was the older brother. At one time he drove a stagecoach that carried mail in Colorado. (67) He was also the inventor of an aluminum scribe for marking trees. He surveyed in several western States. Later, for about 15 years, he worked in various eastern States. To clarify

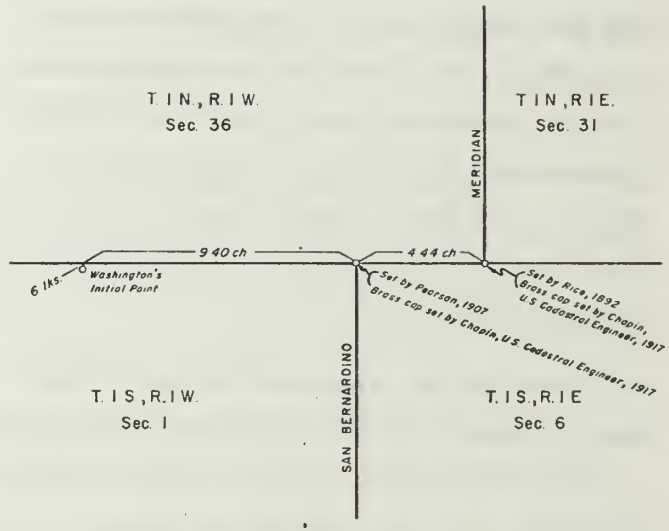
that statement it should be explained that he surveyed in the East, but he would not live there. For all those years, his home was in Denver, Colorado. (64)

Tom Crawford became the office engineer in Montana in the early 1950's. He had worked for many years and in many places, including Nebraska. That is the State where John S. Knowles, later the office engineer in Denver, Colorado, (64) started his career. His first survey job was in 1912, when he was only 16 years old. Mr. Knowles has recalled that, "In those days, if the field engineer let you off on Sunday, you thought he had gone soft." Mr. Knowles has also talked about trying to retrace old lines in Nebraska. The surveyors could, sometimes, find almost no evidence of a survey. At one time, John Knowles complained about the lack of corners to an old contract surveyor who had done original surveys in the area. John Knowles told the surveyor, who was "about 94 years old", about the hard time they had finding corners. The old surveyor sympathized by telling Mr. Knowles that it was sometimes hard to find those corners 2 days after they had been set. They used wooden stakes at that time, and the Indians removed them to use for firewood in that treeless prairie land. Resurveying in that area, Mr. Knowles found, meant that the surveyors had to look for "any physical evidence they could find; buried charcoal, axe marks, a stack of buffalo horns, mounded sod, --- anything the original surveyors might have used to mark or witness their corners." (62)

Another surveyor who started his career about the same time as John Knowles was Dupree R. Averill. He was born shortly before 1900, and started surveying in about 1914. One of his survey assignments was in a then remote part of Arizona, the Kofa Mountains. He was flagman, and decided to give the instrument man a point he could not occupy with the instrument. He found his opportunity when a tall chimney-like pinnacle fell on the line. He, somehow, climbed it. The instrument man refused to play his game and simply ran an offset line around it. (70)

It was at that point that Averill found that he could not get off the pinnacle. The obscure little hand and foot holds he had used on his way up were not visible as he looked downward. The survey party left him there overnight to teach him a lesson. In the morning, before his rescue, he had plenty of time to look over the surrounding country. Some little distance away, completely hidden by rocks from every place except his vantage point, he saw trees in a green, cool-looking canyon. The trees he saw were palms. After the survey party had performed their rescue mission, Averill told them what he had seen. They worked their way to the area he pointed out, and there, just as he had described it, was a beautiful, palm-tree filled canyon, hidden in an area where there are no other palm trees. (70) It is now shown on highway maps as Palm Canyon, a point of interest.

Several years later, Averill worked in another unique situation. It had to do with Initial Points on the San Bernardino Meridian and Base Line. The plural is correct; points, not point.


T. I N., R. I W.
Sec. 36
T I N, R I E.
Sec. 31
MERIDIAN
9 40 ch
4 44 ch
6 lks.
Washington's Initial Point
Set by Pearson, 1907 Brass cap set by Chapin, U.S. Cadastral Engineer, 1917
Set by Rice, 1892 Brass cap set by Chapin, U.S. Cadastral Engineer, 1917
T. I S, R. I W.
Sec. 1
SAN BERNARDINO
T. I S., R. I E
Sec. 6

Initial Points of the San Bernardino Meridian and Base Line as determined by the Washington Initial Point Resurvey Expedition.

Due to an unusual series of events, which occurred over a period of years, there are now three Initial Points for the San Bernardino Meridian and Base Line. (These points and the surveys that established them were resurveyed a few years ago by employees of the San Bernardino County Road Department as commissioned by the San Bernardino County Museum. The group, commissioned on June 1, 1966, was called The Washington Monument Resurvey Expedition.)

The story of the three Initial Points began when a deputy surveyor named Henry Washington established the first Initial Point in November 1852. The problems he encountered, including the lack of sufficient funds and the height of the San Bernardino Mountains are well described in a letter he wrote to the surveyor general of California the following month. He did not survey the Meridian and Base Line from the point he had established. (107)

In 1876, deputy surveyor Albert Ruxton surveyed in the area and left, among other corners, one monument only 2 miles away from Washington's Initial Point.

Deputy surveyor John C. Rice completed the survey of the Meridian from the north, probably along Ruxton's line. He reached the Base Line at a point he showed as 13.45 chains east of Washington's Initial Point. Rice established a second Initial Point at that location. (The distance of this point from the first Initial Point was measured by the Washington Monument Resurvey Expedition as 14.04 chains.)

In 1907, George W. Pearson, deputy surveyor, set a third Initial Point when he completed the survey of the Meridian from the south. Pearson reached the Base Line at a point he said was 4.20 chains west of Rice's monument.

In 1917, Frank W. Chapin, a cadastral engineer, surveyed a part of Township 1 South, Range 1 West. Since surveys in the area were tied to them, Chapin accepted both Rice's and Pearson's points. He reset them with brass-capped standard iron posts. These points have been measured as 4.44 chains apart.

In 1927 a United States surveyor named Dupree

R. Averill set a brass-capped standard post beside the original 1907 marker set by Pearson. He also set the standard corner between Range 1 East and Range 2 East next to Pearson's marker of the same point.

The San Bernardino Meridian is offset 4.44 chains at the base line. Washington's Initial Point would have put the Meridian 9.40 chains west of the 1907 Pearson monument. It also lies 6 links south of the present San Bernardino Base Line according to later measurements. (107)

Dupree R. (for Reed) Averill's name might not be recognized by his associates, because he was for many years called "Herk". (70)

Herk Averill's name was given to him by a couple of men who were trying to load some water barrels onto the bed of a rig they were using for their survey. The two men heaved and struggled with the barrels, which were not light when filled with water. They finally found what they thought was a clever solution. They arranged a couple of boards as a ramp, up which they intended to roll the heavy barrels.

Just at that moment, Dupree Reed Averill walked by and asked them what in the world they were doing with the boards. When they pridefully explained, Averill snorted in disgust and said that he would show them how to load water barrels.

There is a trick to loading something of that sort. Men on the survey crews learned to let the weight and motion of such objects work for them. Averill rolled the barrel to the back of the rig after the boards had been taken down. He quickly tipped it up on its rim, and as its momentum helped him, he leaned the barrel, used his knee for leverage, and heaved the 400 pound barrel up into the rig.

From that moment on, he was known as "Herk". It was the men's way of admiring his "Herculean strength". (70)

Guy P. and Earl G. Harrington were both with the General Land Office and the Bureau of Land Management for many years. At the time Everett Kimmell and Wendell Hall were working in New

Mexico in the early 1930's, Guy P. Harrington was the District Cadastral Engineer there. (61)

In 1908, when he was about 18 years old, Earl G. Harrington, Guy P. Harrington's younger brother, became a field assistant on a General Land Office survey party in Minnesota, his home State. It was the beginning of a long career in cadastral surveying. (109)

In 1928-29, Earl G. Harrington, then a cadastral engineer, resurveyed a part of the Michigan-Wisconsin line, under the direction of commissioners representing the two States. The line he re-established was originally surveyed by William Austin Burt, in 1847. (32)

Earl Harrington located the stumps of two of the original bearing trees, and a small, circular mound of stone about 6 inches below the ground surface. These marked the western end of Burt's line. The east end of the line was re-established from what Mr. Harrington believed to be the first bearing tree Mr. Burt marked on this line. Mr. Burt's name, the date,and the initial mile number were found inscribed on the tree.

Not quite three-quarters of the original mile and half-mile corners were found by Mr. Harrington. In a few places, stone monuments were found. In most cases where one of Burt's corners was found, the location of at least one of the original bearing trees enabled Mr. Harrington to find the corner. Sometimes the outer chip removed from an old bearing tree showed the mirror-image of the markings as plainly as the original markings appeared on the tree itself.

Mr. Harrington reported that the line surveyed by William Austin Burt varied only slightly from its intended bearings and distances. He credited it with being one of the best of the early surveys. (32)

Earl G. Harrington was Cadastral Engineering Staff Officer of the Bureau of Land Management when he retired, in 1959. His career in cadastral surveying had lasted for more than 50 years. Following his retirement, he re-

mained interested in surveying and served as consultant for the Louisiana Land and Exploration Company. Mr. Harrington died in June 1966. (109)

Donald B. Clement became Cadastral Survey Staff Officer of the Bureau of Land Management following Earl G. Harrington's retirement. At the time he accepted this position he had been involved in cadastral surveying for almost 50 years.

On August 20, 1910, Donald B. Clement, who, like the Harringtons, was from Minnesota, joined a survey party in eastern Montana. He was about 18 years old, and his job was digging holes and planting corner posts. It is interesting to note that the date he started his career with the General Land Office was exactly 125 years after the establishment of the Point of Beginning of the United States system of rectangular surveys. In 1914, Mr. Clement went to Washington, D. C., and with the exception of 2 years with the Iowa State Highway Commission, he remained there the rest of his life. He attended Valparaiso, Indiana and George Washington universities. In later years, he earned a reputation as an expert in solving riparian rights problems. Mr. Clement retired from the Bureau of Land Management in the early 1960's, and died in late November 1965. (108)

Minnesota was the State where still another long-time cadastral surveyor got his start. His name was Andrew Nelson. He was first employed in the survey of the public lands in 1904, when he was 16 years old. Young Andy Nelson was assigned to work with an examiner checking surveys near the Minnesota-Canada boundary that first winter, and he and the examiner worked through temperatures of 50° below zero. They traveled by canoe or snowshoes, and the main part of their diet was moose meat. For some reason, cold and hardship did not cause Andy Nelson to abandon surveying as a career. In 1908, he was transferred to surveys in Nevada and Utah. (84)

Andy Nelson was given a temporary appointment in 1910, when the contract system was discarded in favor of the system which allowed the

General Land Office to form its own group of competent surveyors.

Six years later, in 1916, Andrew Nelson and Birdie Morrison, daughter of Cashe Valley, Utah pioneers, were married. They had four active children, three daughters and a son. Later, that small son also became a cadastral surveyor.

In 1917, after taking a Civil Service examination, Andy Nelson accepted a permanent appointment as a cadastral engineer. His career took him to a dozen states, and over some of the wildest, most rugged terrain on the globe, even the deeply carved, perpendicular scenery of Bryce and Zion canyons. (84)

Andy Nelson used to tell about his survey of the southern part of the Salt Lake Meridian. It had been run south from Salt Lake City to a mountainous area, but not all the way to the Utah-Arizona boundary. Andy was given the task of establishing the southern end of the meridian so that surveys could begin in the southern part of the State. He and another surveyor spent several days making observations, and completed their task.

In later years, both ends of the Salt Lake Meridian were finally joined. The two ends missed an exact connection by less than a quarter of a mile, which was at that time considered quite accurate for longitude. (61)

At one time, Andy Nelson found himself in a very thirsty condition. He was on top of a rim in Paria Canyon, just south of the Arizona boundary. Paria Canyon is another bit of spectacular scenery. The walls of the canyon are mostly vertical rock. Water had to be hauled to the work sites because there is no water on those canyon walls. On this particular occasion, Andy had sent his cook, with the team and wagon, into town for supplies and water. The cook had not returned, and all the water Andy had with him, one bucketfull, was gone. Since his thirst was almost overpowering, Andy worked his way downward onto a ledge. He tied two five-chain tapes together, which gave him

a good long line. He hooked the empty bucket on one end of the line, and lowered it down toward the Paria River. His line was not long enough to reach the river, so he climbed back up the canyon wall to the top of the rim and stayed thirsty until the cook came back. (61)

During the course of a 1926 survey, Andy Nelson looked through his transit and saw a part of a wagon wheel. That barely-visible wheel led him to what was left of three wagons that had been abandoned by the unfortunate Donner party as they crossed the Great Salt Lake Desert in 1846. On this same survey, Andy Nelson found other evidence of preservation in this desert. He had to tie his survey to one done nearly 30 years earlier, and it turned out to be so easy he could hardly believe it. He found the tracks of the other survey party clearly marked in the salt. He literally followed the footsteps to the corner he sought. (84)

For more than 50 years, Andy Nelson was a cadastral surveyor. He often told people that he enjoyed his rugged life. Perhaps that is why, even when he was past the age of 70, he remained as strong and lean as a whip. (66) After he retired, he returned to BLM to execute some special surveys in Utah. He was then well into the years when many men choose to sit in the sun rather than hike up a mountainside. Until shortly before his death in the middle 1960's, his step had a spring to it, and his hair was without a streak of gray.

While he was still an active surveyor, Andy Nelson became almost a legend. It was said that he had surveyed more miles than any other cadastral surveyor. It was also said that he made it a practice to supervise the marking of each corner on his surveys. Men who have retraced his lines have found they could depend upon the accuracy of surveys done by Andy Nelson. (66)

Roger F. Wilson, California's most prolific surveyor, retired in 1963 with a record that puts him in the same exclusive league with Andy Nelson. At his retirement, Mr. Wilson was given a "diploma" which indicated that he had signed his name under 36,000 miles of various types of surveys during his career as a cadastral surveyor.

Ten to 40 miles each week for 6 months or more of each year for more than 42 years, adds up to a lot of miles. They were miles he had not planned on when he was a young man just out of high school.

A bad ear kept Roger Wilson out of World War I, and at the beginning of 1919, he had, "a cushy job that netted more than 300 [dollars] a month...and no worries." He also, occasionally, helped out in his father's Denver, Colorado automobile agency. After his father's death in February 1919, the job of selling the cars remaining on the floor fell to Roger. While he was at the agency one day, an old high school friend, Johnny Knowles, came by. Johnny was home from the war and bursting with excitement. He had passed the examination for U. S. transitman before he marched away to war, and now at last, he was getting ready to leave with his first field party. (69)

John Knowles must have made cadastral surveying sound like the good life, because on May 13, 1919, Roger Wilson, whose background in surveying consisted of a good foundation in mathematics and a genuine liking for trigonometry, boarded a train with Hans Voigt and was off to the canyon of the Grand River. Roger's pay was plenty of fresh air and 60 dollars a month, though he did work all the way up to 75 dollars a month that season. His first assignment was as notekeeper (rear chainman) for John S. Knowles. Roger spent part of his pay for a Marble's belt hatchet. One was not furnished him because, at that time, John Knowles did not think blazing trees was proper work for a rear chainman.

That summer, Roger Wilson's education in the survey of the public lands began. He credits Hans Voigt with being one of the best instructors the General Land Office ever had. Mr. Voigt arranged his instructions so that the men had to become involved with the problems. This was accomplished so smoothly that they did not even realize until later that they were being taught. For instance, Roger Wilson remembers that he was required to get up at 3 o'clock in the morning to take an observation on Polaris, at elongation, to "check" the hour angle Hans Voigt had taken at a more convenient twilight

hour. He learned to keep notes by being sent out with an experienced drag chainman, to re-chain a mile of line that "didn't close" and write down the topography as it was called off to him. From the following day, Roger Wilson was on his own, having learned exactly what Hans Voigt planned for him to learn. Soon John Knowles had Roger preparing the daily solar declination chart, and course and distance diagrams. Roger learned to close his own sections within half the allowable limits, and also to close the elevations within 50 feet, a far from simple matter.

On November 13, 1919, Roger returned to Denver and his old job, which somehow did not look so good to him anymore. He was with the survey party again in May 1920, when they finished the work begun the year before in the beautiful-but-rugged Colorado Rockies. By that time, John Knowles had Roger Wilson "checking his transit all day Sundays on the camp meridian and reading the 'Bible' [Manual of Instructions] in...[his] spare time."

On February 9, 1921, Roger took the examination for U. S. transitman and the next day he was on a train headed for another job. Joe Davis had a survey party in the northwestern corner of Arizona, and he needed a notekeeper. Roger spent 3 months there, and for that 3 months work he received 225 dollars. That was just about what his train fare and incidental expenses had cost him. He was back in Denver in time to go to southeastern Colorado with John Knowles early in June. That area is prairie land, and they timed themselves once at 1/2 mile in 9 minutes. They dragged the tape out all 5 chains and gave it a flip. The rear chainman held 5.00 next to the pin on the ground, the front chainman stuck the pin at 0.00. When he had used his 8th pin, they got lined in for the corner point. John Knowles kept up with the chainmen in a "Model T" converted flatbed truck.

Roger went back to Denver in December. He had passed the examination and accepted a temporary appointment in California. The day he left for California was February 13, 1922. The train

dropped him at Goff, which is situated some miles west of Needles, California and "some miles in any direction from any place else fit to be inhabited."

He was picked up by the truck driver and they drove for miles along dirt tracks to the survey camp. It was here that Mr. Wilson met his first Young and Sons transit. He had learned to use a light mountain Buff transit, and found the Young and Sons about 10 pounds heavier, with a four point suspension on the solar attachment. Mr. Wilson has a very clear recollection of the work involved if it ever got out of adjustment.

John (Pop) English was the surveyor on this party, and after they left the desert he ran into some poison oak. He was allergic to it, so he and his crew went on to the next assignment northwest of Fillmore, California, leaving Roger and his crew northwest of Los Angeles. When Wilson's crew finished that job, they rejoined English. Unfortunately, by the time they got there, English had discovered poison oak at that camp too. He went on to the next assignment in Cuyama Valley, with his crew. By this process, Roger Wilson became chief-of-party whether he was ready or not. This circumstance also prompted him to write a lot of letters to the office in regard to the special instructions which were issued from the office. The man who prepared them tried to visualize all the possibilities and provide for them in the instructions. Naturally, the instructions did not cover all the situations that Roger encountered on the ground. Because of his inexperience as a party chief, Roger's correspondence requesting advise became voluminous. By the end of the year he apologized for writing so many letters and sending so many sketches. He was assured that it was a lot better than being forced to do the job over.

At the end of the Fillmore job, Roger Wilson and his crew went to Cuyama Valley to again rejoin English. Poison oak also grew in Cuyama Valley. At this point, Glen Sawyer came from Montana to take over English's survey party. Since California was not especially to Sawyer's taste, Roger Wilson soon became chief-of-party;

and Ty White, who had passed the examination for U. S. transitman while working as their truck driver, was given the job of transitman under Roger.

From that time on Roger had his own field parties except for a part of 3 or 4 years in the 1920's when he worked with Carl Seibecker, and with Herk Averill. For about 25 years, J. D. Dukes was the camp cook who kept Mr. Wilson's survey parties fed. Tom Winkler was one of his principal field assistants for about the same length of time.

For most of his long career, Mr. Wilson surveyed in California, Nevada, and Arizona; but in the mid-30's he was assigned to a job near Spartanburg, South Carolina. During that time he was in unusually good company. Some of the lines he resurveyed were property lines that had originally been surveyed by George Washington. (69)

Roger Wilson always took pride in the surveys he executed under the General Land Office and the Bureau of Land Management. He used to tell the men on his survey crews to pretend the land they were surveying was worth a thousand dollars a foot instead of the less than nothing it sometimes appeared to be. He set a good example because that was exactly the way he ran his lines. It is interesting to note that some of those surveys are now used to describe land valued at very nearly that once seemingly absurd amount of money.

LEFT: Quintin Campbell, U.S. Transitman, in Oregon, 1917.

ABOVE: Survey of the 9th Standard Parallel North, T.37N., R.ZE., Arizona, November 1925. William E. Hiester, U.S. Surveyor, at the transit.

BELOW: Mr. A. C. Horton (left) and his packer are shown catching up on their reading. The camp is under the bamboos during the Indio Desert survey investigations. The photograph was taken during the winter of 1915-16. The place was T.5S., R.6E., S.B.M., California.

ABOVE: Unidentified cadastral surveyor in camp adjusting what appears to be a Young and Son transit. Photo probably prior to 1920.

LEFT: A fall camp in southern Idaho, 1919. The men in the photo are not identified, but second from left may be George F. Rigby.

RIGHT: Survey camp on Blackfeet Indian Reservation on Milk River, Montana, 1922. Divide Peak, Glacier National Park, forms the background. W. R. Bandy, Ernest Parker, D. W. Eaton Camp. (57)

ABOVE: Typical Nevada desert survey, 1949. The instrument is a Gurley transit. (70)

LEFT: Humphrey Mountain on the east boundary of Yellowstone Park, 1931. The men at the top of the peak are building a corner. There is another corner on the rock under W. R. Bandy's transit. (57)

ABOVE: July 1940, survey of islands in the vicinity of Point Lobos, California. The man's name is Calvin and the walkway is a pipe.

RIGHT: Survey of the north boundary of Yellowstone National Park, at the head of Pebble Creek. The corner is on the top of the peak; the time is the early 1930's. (57)

W. R. Bandy's crew, 1931.
Left to Right: W. R. Bandy, Tingley,
Jack Morris, Ariel Barney, Don Thompson,
Marvin Thompson, Frank Montbilier.

The men are carrying survey equipment,
blankets, food, tools, and corner posts.
Where they are headed, 2,000 feet up
to the top of the ridge at the foot of Cody
Peak, the going is too rough
for pack mules! (57)

The two surveyors at the top
of the photo are looking at
the place where the survey
line crosses the Gunnison
River in Colorado. The river
is 2,500 feet below them.
Group 333, 1940.

United States cadastral survey office, Helena, Montana, April 14, 1930. Seated Left to Right: Guy H. Richardson; A. T. (Alex) Harris; J. Scott Harrison, assistant supervisor of surveys; George F. Rigby; H. B. or A. H. Hibbard, mineral draftsman.

Standing Left to Right: Ernest Parker, Ranney Y. Lyman; Phillip Inch; Claude F. Warner; W. R. (Roy) Bandy; Fred L. Cumming; Dan P. Mumbrue; George F. Tyrrell draftsman; Melvin J. Davis, chief clerk; H. J. (Jim) Goodall, office engineer; Minerva Thomas, clerk. (57 & 63)

William B. Kimmell in camp in Wyoming. The year is unknown. He is holding a young wildcat.

A. C. Kimmell was called "Tony." It is believed that this photograph was taken in Arkansas, year unknown.

LEFT: A. N. Kimmell and party on the roof of the Federal Building in Anniston, Alabama, May 1918.

Left to Right: Unknown, Hal D. Craig, Frank Constantine, unknown, A. N. Kimmell, Thomas E. Heister, Jim Quigley (?), Arthur C. Buttrick.

RIGHT: Near Cimarron, Colorado. The year is not known, but the man on the left in the wagon is Everett H. Kimmell.

A. N. Kimmell, fifth from left in the above photo, was Everett's father. William B. and A. C. Kimmell were Everett's uncles.

Chainman Sam Roberts took this picture of W. R. Bandy in 1937 during a survey (retracement) of the Montana-Wyoming boundary line. The boundary line runs east and west through the boulder-filled jungle in front of the surveyors. (57)

A mountain stream greets General Land Office surveyors Guy R. Veal (transit) and Hugh Crawford (steel tape).

Looking for a pack trail route to the isolated eastern part of Yellowstone National Park in 1932 are, Left to Right: Ariel Barney, W. R. (Roy) Bandy, and Ed Wilson. (57)

See picture behind Mr. Bandy in photo on opposite page.

Shown going down Notch Mountain on the eastern boundary of Yellowstone Park in 1932 are Jack Morris (top) and Oliver Tingley. (57)

ABOVE: Mr. Guy P. Harrington, BLM District Cadastral Engineer, March 1941.

RIGHT: Mr. W. R. (Roy) Bandy and some of his trophies, circa 1940. Note model 70, 30-06 Winchester rifle, Weaver scope, high-laced boots and pictures on wall. (57)

LEFT: A cook tent in some rugged country--a spike camp, section 14, T.37N., R.109W., Wyoming, 1935. Pictured are Arnold Bigler and a friend.

BELOW: A two-man mosquito tent in camp near Campbell Creek, south of Anchorage, Alaska, 1950. Notice the boots. (70)

BELOW: Wyoming, 1935. Left to Right: Lester Stoll, Charles Hansen, Dave Todd, Dick Simmers, Bill Anderson, Leo Peterson (instrument man), Willis Brown, Elmer Lenhart, Victor Stalick.

RIGHT: Pack train halts so the packer can check the loads. The survey party is moving along the eastern boundary of Yellowstone National Park in 1932. There is rough country ahead. (57)

LEFT: W. R. Bandy's pack train moving along the eastern boundary of Yellowstone National Park at the top of the Absoraka Range, 1932. (57)

ABOVE: In camp during 1936 survey of Mount McKinley National Park boundary, Alaska. Left to Right: Herbert C. Torgerson, Leonard M. Berlin, Kenneth M. Nelson, Grant Pearson.

UPPER RIGHT: Leonard M. Berlin setting up a transit north of Sitka, Alaska, in the spring of 1946. He is not wearing the usual survey attire because he had to make a trip to town. (70)

LOWER RIGHT: 1936, near the base of Mt. McKinley. The crew rests on their trek back to the railroad after completion of their assignment. Both men and dogs are used to backpack all equipment.

ABOVE: Mr. Herman Jaeckel in his office, U.S. Customs House, Denver, Colorado, April 7, 1941. (57--Terry Jaeckel photo)

Group 312, Survey camp near Pike's Peak, T.15S., R.68W., Colorado, 1938, Thomas W. Crawford's party.

RIGHT: Thomas W. Crawford. Year and place not known. (57)

ABOVE: A. C. (Tony) Kimmell in May 1938. The camp is in the desert south of Wamsutter, Wyoming.

Glimpses of carefree, riotous life in the survey camps.

Emil Voight (pipe and all) in his 1949 survey camp near Cottonwood Springs, west of the Seven Troughs Mountains in Nevada. (70)

Dupree R. (Herk) Averill at Cuyama Valley, California, during the winter of 1948-49. (70)

August 26, 1948. Utah-Wyoming State line near mile post 37. The survey party is under the direction of F. Wayne Forrest. The man in the foreground (kneeling) is stamping the section number into the brass cap of a survey monument.

Dupree Reed (Herk) Averill in the southwestern part of Arizona during the winter survey season of 1946-47. Note gear packed on truck. (70)

Elliot Pearson at camp at Gila Bend, Arizona, 1947. The instrument is a Hellgate model Gurley transit. (70)

ABOVE: Emil Voigt and Marion Clauson in Nevada, 1949. Mr. Clauson was Director of BLM from March 1948 until April 1953. (70)

TOP LEFT: Surveyor on rocky pinnacle in the Seven Troughs Mountains west of Lovelock, Nevada. (70)

LEFT: A 1/4-section corner in T.29N., R.27E., Mt. Diablo Meridian, near Cottonwood Springs, west of the Seven Troughs Mountains in Nevada. There are thousands of similar corners in the United States. (70)

Andrew Nelson, doing what he did for more than 50 years—looking through a transit. (66)

LEFT: August 26, 1948. F. Wayne Forrest at a Buff Solar transit.

The two young men with Mr. Forrest are Robert C. Mountjoy and James M. Smith. The iron post under the transit is the 1/4-section corner between sections 19 and 30, T.18N., R.120W., Sixth Principal Meridian, near the Colorado-Wyoming boundary. It was established in 1909.

THE DIRECT SYSTEM

"And the border shall go down to Jordan, and the goings out of it shall be at the salt sea: this shall be your land with the coasts thereof round about."

Numbers 34:12

Conrad G. Carr was a homesteader. He was also a circuit judge, and he helped form Vernon County, in western Missouri. The land he homesteaded there became the home of his daughter, Clara, and her husband, Charles B. Bandy. (57)

Judge Carr's grandsons; Richard E. (Elmer), W. R. (Roy), and Willis W. Bandy were all born on the Carr homestead in Vernon County. Elmer was born on Lincoln's birthday, 1880; Roy, exactly 5 years later; and Willis, in August 1890. They all attended the one-room Willow Grove country school. Later, Elmer and Willis went to college at Warrensburg, Missouri, and Roy attended college at Sedalia.

Elmer taught school in Routt County, Colorado, for a couple of years, and in April of 1904, he joined the public land survey crews of Colonel Samuel W. Brunt and his son, Arthur H. Brunt. Arthur was a well-known engineer and surveyor, and both of the Brunts were, at that time, contract surveyors for the General Land Office in the Big Horn Basin of northwestern Wyoming. Colonel Brunt was a gray-bearded, twinkling-eyed veteran (57) who had held survey

contracts in California as early as 1879. (52)

The Colonel asked Elmer if he had any brothers back in Missouri that he could send for, and in June 1905, Roy Bandy joined the Brunt survey party at Garland, Wyoming. (57)

One of Roy Bandy's first public land survey jobs was as chainman on Arthur Brunt's contract for the survey of part of the Twelfth Standard Parallel North, in Wyoming. The line ran westward from a point 15 miles north of Worland, Wyoming, across a rough 60 miles to Carter Mountain, which is west of Meeteetse. The first 40 miles of the survey line were through desolate, arid, rock-covered, badland country. (98)

Early in July, the nine-man crew left Cody, Wyoming. Their two wagons were loaded with surveying equipment, tents, beds, and cooking equipment. The men rode atop the loaded wagons. They traveled in this manner for about a hundred miles, until they reached a log house on the west wide of the Big Horn River. That log house was Worland, Wyoming.

The tents they carried with them were fine for sleeping, but the furniture was none too fancy. Sometimes they had a wooden box to put a candle on near the head of their bedroll. The men supplied their own bedrolls and their own soap and other toilet articles. These were kept, cowboy style, in a sack called a "warbag." If the survey party planned to be in a certain location for just a couple of nights the men did not bother with tents, they just used the night sky for a roof.

In Wyoming the nights are apt to get a bit frosty, so the surveyors used the cowboys' way to get dressed in the morning. They crawled out of the bedrolls, putting their hats on first, next, as their shoulders emerged, their shirts and coats, then, as they worked their way out, their pants. Last of all came their boots. Their clothing was all kept under the head of their bedrolls where it was both handy and protected by the tarp.

Breakfast was at 6 o'clock in the morning and supper was at 6 o'clock in the evening which created a 12-hour work day. The men hiked to

and from the work area. They carried their lunch in a handkerchief, or a piece of flagging, tied to their belts. The quart canteen of water they packed with them had to last all day, and some of those days were long and hot.

The survey line was run with a solar compass or a solar transit. A one-chain steel tape was used, and the tape was leveled. The modern clinometer had not yet been invented. The chainmen kept track of the distance by the time honored method of counting the tally pins, one pin for every chain. If the ground slope was steep and it was necessary to take less than a chain, a mark was made, and the pin stuck in the ground when the full hundred links were reached. The chainmen, in this instance, Arthur Brunt and Roy Bandy, took turns going ahead with the chain. They changed every ten chains. The same man always started out from a corner and went ten chains. The front chainman had ten pins, and when the last of them was stuck into the ground he would call out, "Tally one." The rear chainman then walked up counting his pins. If the count was ten pins, he would say, "Tally one, ten pins." In this manner it was known immediately if either one had lost a pin. If one was missing, they went back, also in the time honored manner, and chained it over, in order to be sure of the distance. The rear chainman took the lead for the second ten chains. One man always had all the even numbered tallys and the other man had all the odd numbered tallys.

The importance of the starting man having ten pins is obvious when one understands the system. Arthur Brunt taught Roy Bandy to count his tally pins the last moment before starting out. One morning Roy was standing around, waiting for the transitman to set the flagman ahead before he started chaining. Just before starting, Arthur Brunt asked him if he had ten pins. Roy had counted them, so he told Arthur that he had them. Arthur told him that he must always be sure he had all ten. Roy said that he was sure, because he had counted them. Arthur seemed hesitant and interested, so Roy counted them again. He found, to his embarrassment, that he had only nine pins. Arthur

Brunt had actually slipped the other pin right out of Roy's hand as he stood waiting for the transitman. It was a lesson he never forgot.

On this survey, where they were running a straight line all the way, camp was moved about every 2 days. For 2 months they surveyed the line and set stone corners. At the end of the 60 miles, they went on to another job, that of subdividing a township on the east slope of Carter Mountain. During that entire 4 month survey season they saw only one town. They visited Meeteetse, Wyoming, and since, in that year, the whole town consisted of one general store and three saloons, they were able to see all they wanted of it in just one evening. (98)

The following year, 1906, Roy Bandy was appointed a United States deputy surveyor by Alpheus P. Hanson, the surveyor general of Wyoming, as a joint contractor with Arthur Brunt, for the survey of six townships in the Big Horn Basin. At that time it was understood that Roy Bandy, age 21, was the youngest of all the United States deputy surveyors. The contract was completed in the summer of 1907. Later that year, Roy was employed by the United States Reclamation Service, which had been created under the Reclamation Act in 1902 as the Division of Reclamation. It became the Bureau of Reclamation in 1923. Roy Bandy worked on the Shoshone Project. He remained with the Reclamation Service until he went back to work for the General Land Office as a surveyor, in the spring of 1911. Elmer Bandy stayed with the Brunts until 1909. (57)

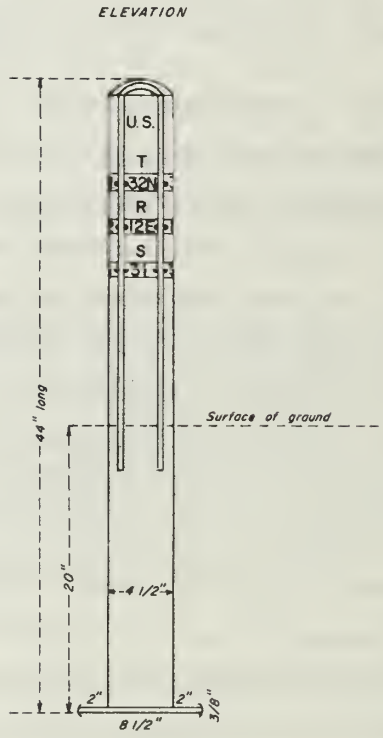
The year before Roy Bandy rejoined the General Land Office, some important changes in the cadastral survey system of the United States were put into effect. When the Act of March 3, 1909 was amended and passed on June 25, 1910, it provided for the resurvey or retracement of the surveys of the public lands in order that they might be properly marked. It also provided that the surveys and resurveys were "...to be made by such competent surveyors as the Secretary of the Interior may select,...." This provision of law ended the practice of letting contracts for the making of the surveys of the public lands. After passage of this

legislation, surveyors were hired directly by the General Land Office and surveys were executed under what has since been known as the direct system. Under the direct system the surveys improved, as was expected. An unexpected change also took place; the cost of executing the surveys went down. (32)

That same year a standard iron post was adopted for monumenting the public land surveys. Up until then, the identifying corners, the vitally important markers which made up the physical on-the-ground record of the surveys of the public lands, were made of whatever materials came to hand. Often these materials were wooden posts, or sod or stone mounds. The wood was subject to deterioration, the sod could flatten, and the stones could become scattered.

In the Land Office Report of 1880, the surveyor general of California, Theo. Wagner, stated that it was a "matter of surprise" to him that action had not been taken long before, toward a "system of monumentation calculated to perpetuate the corners of the public surveys."

DESIGN
for
IRON MONUMENTS
for
PUBLIC SURVEYS



THIS DESIGN APPEARED IN THE 1880 GENERAL LAND OFFICE REPORT

He noted that many of the corners which had been established a comparatively short time before were already obliterated. He made strong recommendation that "iron monuments.... be used to mark the corners of the public surveys...at as early a date as possible."

With his recommendation he sent a detailed description and a drawing of a design for a metal marker. He estimated that in San Francisco it would cost, including the township, range, and section plates, and the screws to attach them, $6.25. Since the marker was to be 4-1/3 inches in diameter and 44 inches long, with a heavy extended base, and since the whole thing was to be made of metal three-eighths of an inch thick, it is no wonder that he figured it would weigh in at about 80 pounds. (52) Even though he was right about the need for a standard metal marker, surveyors will agree that it is a good thing a less cumbersome one was accepted. It took a long time, in fact more than 20 years went by after Theo. Wagner submitted his design, before the General Land Office finally contacted people in the iron and steel industries with a request that a metal marker be devised. It had to be economical, of a size that could be carried, easy to install; and, most important of all, it had to last. (87)

At first they tried using different sizes of pipe to mark corners of different types. For example, a 3/4-inch nominal iron pipe size (called 1 inch by surveyors) was used to mark quarter section corners. A 2-inch (1-1/2 inch I.P.S.) pipe marked section corners, and a 3-inch (2-1/2 inch I.P.S.) was used to mark township boundaries.

After experimentation, the marker finally evolved into the standard iron post now in use. It is a 30-inch long, wrought-iron, zinc-galvanized pipe. Its inside measurement is 2 inches, and it has flanges at the base so it can be firmly anchored. Standard posts weigh about 12 pounds and have a brass cap securely fastened to the top. The brass caps are inscribed with information identifying the corners they mark.

It has been stated that the Stewart brothers, on a survey near Green River, Wyoming, set the first of the many thousands of these posts which now mark the surveys of the public lands. It is estimated that they will endure for at least a hundred years.

At the start of the direct system, Elmer Bandy was employed as a cadastral engineer by Mr. Frank M. Johnson, who was Supervisor of Surveys for the General Land Office. Elmer was assigned to Montana under Mr. Johnson's assistant, J. Scott Harrison. Elmer Bandy executed one of the first surveys under the direct system. Elmer stayed with the General Land Office and worked in Montana, Arizona, and California until he grew ill in 1915, while surveying in Arizona. (57)

Mr. Frank M. Johnson also hired another young surveyor, a man named Addison Ralph Teller, who happened to be Mr. Johnson's brother-in-law. Mr. Teller was from Cleveland, Ohio, and had attended the University of Chicago. Mr. Johnson assigned him the job of examiner of surveys in Nebraska, Minnesota, and South Dakota. Mr. Teller moved to Colorado in the early years of the 20th century, and was a surveyor there for many years under the direct system. Mr. Teller's father had moved to Colorado, and his uncle had lived there for many years. Addison R. Teller's uncle was Henry Moore Teller, who became a Senator from Colorado when Colorado became a State. Henry Moore Teller was, in the early 1880's, Secretary of the Interior under President Chester A. Arthur. (67)

Wilford Utterbach and Roy Bandy had both run survey crews for the Brunts, and in 1911 they both were employed as cadastral engineers out of the surveyor general's office in Cheyenne, Wyoming, along with the Saxons, the Pidgeons, Mark Kelly, Herman Jaeckel and the Voigt brothers. (57)

1911 was also the year Roy and Inez Bandy were married. Inez, who had grown up on a farm in Missouri, was a pretty young woman with a sunny disposition. Since the Bandys had been married only a short time, they really did not want to be apart for a whole long survey season. They

finally found a way for Inez to go along. No one was allowed to stay in a government survey camp unless they were part of the crew, so she became the camp cook. Inez cooked for parts of four summers. One incident from the summer of 1912 has been immortalized in a fine painting by Montana artist, "Shorty" Shope. The painting, owned by Mr. Bandy, is from a photograph. It shows Inez cooking breakfast, at a survey camp, high up in the Big Horn Mountains.

Willis Bandy was on the survey crew, and it was he who had bagged the savory, succulent mountain grouse Inez served that August morning. Willis had spotted the grouse the day before as they followed an ancient Indian trail. It was dusk when they found themselves near an enormous bank of the previous winter's snow. The water provided by the melting snow made it a most attractive camping place. The rings from Indian tepees, still visible on the ground the next morning, showed the surveyors that they were not the first to camp there.

In 1914, Roy was transferred to Helena, Montana under J. Scott Harrison. One of his first assignments was to work with Guy R. Veal and Glen Sawyer on the survey of the breaks along the Missouri River.

The Missouri River Breaks are south of the Bear Paw and Little Rocky Mountains, and are an area of spectacularly fractured land. It is badland country, with strange, abrupt, upward thrusts of sandstone, and canyons plunging to depths of 700 feet. It is a rugged, tortured land, and the few scrub pine and cedar trees that try to grow there are gnarled and twisted to match the rest of the landscape.

While Roy surveyed in Montana, Willis also worked on the public land surveys. He was a field assistant several summers, went on to become a surveyor, and was made a party chief in the 1920's. At about this same time, Glen Sawyer, Ernest Parker, David Eaton, A. Parker Warner, Phillip Inch, and Charley Seeley all ran survey crews, under Roy Bandy's leadership, on the survey of the Crow Indian Reservation.

Ten years later, in 1931, Mr. Frank M. Johnson,

who was still Supervisor of Surveys, asked Mr. Harrison to assign Roy to the survey of the revised east and north boundaries of Yellowstone National Park. The revision of the boundary lines changed them from straight lines that crossed mountains and drainages, to lines following the divides which separated the watersheds. The new east boundary was high atop the divide between the waters flowing into the Yellowstone system, and those flowing into the Shoshone River.

The change in boundary was made to ease the work of the rangers employed by the National Park and National Forest Services. It did not do much to ease the work of the men sent to survey the new lines. The surveyors had to run a broken line along the crest of the mountain ranges, keeping always to the sinuosities of the divide. This meant that the surveyors had to climb the highest peaks, and set corners on them.

Mr. Johnson made a point of having a "spruced up outfit," Roy Bandy had stated. For transportation the survey crew had 16 young pack mules, and three saddle horses. They used new Decker swing-type pack saddles, and their new white canvas tents were a pyramid type. The bunk tents had one center pole, and the 12 by 16 foot cook tent had three upright poles and a rope for a ridge pole.

A little before this survey took place, one of the Kimmell family of surveyors had invented a camp cook stove. Roy Bandy had a Kimmell stove with him on this survey, but he had made some improvements in it. He added asbestos lining around the oven and perfected a telescoping stove pipe. His crew also had roll-top tables of their own design, and good Alpine climbing equipment.

The surveyors learned to make noise, as they moved along, so that the bears would know they were in the area. They knew that a startled mother bear was too busy protecting her cubs to find out if they were being threatened or not.

Some of their young pack mules were unbroken,

so experienced horsemen from Powder River were recruited to break and train them. The mules were soon gentled to a point where they stayed around camp hoping for oats from a nosebag. The mules needed no fences or hobbles to keep them in camp as long as the gray saddle mare was around. For some reason, the mules stayed where the mare was.

It took three summers to complete the survey that established this park boundary. The surveyors climbed upward to the top of 11,360 foot Eagle Peak, the highest point in the park, before their job was finished.

The cadastral survey program was expanded to help promote employment during the dark depression days of 1933 and 1934. Guy P. Harrington was District Cadastral Engineer at Santa Fe, and he divided New Mexico into two areas. Fred L. Cumming, Ernest Parker, Claude (Hefty) Warner, Roy Romberg and Roy Bandy were sent to the west area to run survey parties during that winter. Big, tall, soft-spoken, Glen R. Haste, who had started surveying when he was still in his teens, was put in charge of the east area. Dedicated, hard-working, neatly-dressed Roy Bandy, was the man in charge in the west. The survey projects included the boundaries of National Forest Reserves and National Monuments. Many lines were surveyed and marked that winter, by the men who found work under this employment program. (57)

In the summer of 1934, the Taylor Grazing Act was passed, and the Division of Grazing was formed within the Department of the Interior. It was renamed in 1939, and became the Grazing Service. Under the Taylor Grazing Act, all the remaining unappropriated and unreserved public lands, with the exception of those in Alaska, were closed to unrestrained settlement and use. Mining claims could still be staked upon the lands, and they remained open to outdoor recreation.

Farrington R. Carpenter was the first director of the Division of Grazing. One of his first responsibilities was the classification of the lands, which were mainly in 10 western states. This presented something of a problem, because neither Mr. Carpenter nor anyone else seemed

to know just where the public lands were located or how much public land there was. Mr. Carpenter found that there was only one place where this vital information was obtainable. The township plats of the General Land Office showed the surveys, and the private lands had been marked off on the tracts in the local land offices. (81)

In the next few years, Roy Bandy noticed that, as the Congressional appropriations for cadastral surveys were shrinking, the need for resurveys within the jurisdiction of the Bureau of Reclamation was growing. He was convinced that the cadastral engineers employed by the General Land Office were the men who were best trained and equipped for the work. In 1939, while visiting his close friend, Fred Munro, he mentioned his ideas. Fred was a project engineer for the Bureau of Reclamation, and was setting up the Kinsey project, a plan for the resettlement of homesteaders on the Yellowstone River. (57)

Fred Munro took the survey idea to his superiors, and they allotted funds to cover the survey. When the survey was completed, and Roy gave Fred Munro the sketch plats showing the location of the iron posts, along with the bearings and lengths of all the section lines, Fred and his superiors were well pleased. (57) That survey was the start of the vast reimbursable cadastral resurvey project in the Missouri River Basin.

In 1941, the head office of the Grazing Service was moved from Washington, D. C. to Salt Lake City, Utah. That same year, the various defense agencies discovered the same thing Mr. Farrington R. Carpenter had found earlier; for several areas of the United States, the only maps available were the township plats of the lands surveyed under the direction of the General Land Office. (1)

In the autumn of 1944, R. Y. Lyman, Ernest Parker, and Roy Bandy were engaged in the resurvey of the section lines on the Canyon Ferry Reservoir project. They had no field assistants, and it was a somewhat complicated resurvey. The original surveys on opposite banks of the river were made at different

times, and they were not tied across. The following year, the Bureau of Reclamation granted the General Land Office authority to resurvey the Lower Marias River and Tiber Dam project. That resurvey was executed by Ernest Parker and Roy Bandy. (57)

At the beginning of 1946, Mr. A. C. Horton, then Supervisor of Surveys, and Mr. Herman Jaeckel, the assistant supervisor of surveys for Montana, Wyoming, and Colorado, visited the Helena, Montana office. They announced that the Bureau of Reclamation had requested that all the cadastral surveys in the Missouri River Basin States be executed by the General Land Office.

This area included Montana, North Dakota, South Dakota, Wyoming, Colorado, New Mexico, Nebraska, Kansas, Missouri, and Iowa.

Mr. W. R. Bandy was directed to take charge of the immense project. He was also asked to make preparations to begin the surveys in April. Mr. Bandy obtained authorization from Mr. Horton to call in as many experienced cadastral surveyors as he needed. Funds were made available to him for the purchase of the vehicles and equipment that would be needed.

Right on schedule, in April 1946, Roy Bandy opened an office in Fort Peck, on the Missouri River in Montana. George F. Rigby, who was recalled from retirement, was his helper. Glen R. Haste, acting as Roy Bandy's assistant, opened an office in Flaxton, North Dakota.

In one month they had 18 survey parties in the field. The party chiefs were all experienced cadastral surveyors. Among them were: R. Y. Lyman, Ernest Parker, Andy Nelson, Arthur Brown, Lloyd Toland, Emil Voigt, Russell McDonald, Willis Bandy, Tom Crawford, Hugh Crawford, John S. Knowles, Leo Peterson, Wendell Hall, Ty White, Quintin (Jerry) Campbell, and Claude (Hefty) Warner. (57)

Wendell Hall and his survey party were stationed at Crosby, North Dakota. Ty White's crew executed surveys at Mellette, South Dakota, and later in the summer, they surveyed in the area near McIntosh. Lloyd Toland's survey party

was working in the same area along the Grand River, but they stayed in Lemmon, South Dakota. They were both working on the survey for the Shady Hills Flood Control project, and both towns were near the survey area, but neither town was big enough to have accommodations for two survey parties. (70)

On July 16, 1946, as these surveys continued, the 134-year old General Land Office was consolidated with the 12-year old Grazing Service and became the Bureau of Land Management.

By early fall, Ty White's party had moved again; this time to Bowbells, North Dakota. Most of Ty's men were accustomed to surveying in California, and they were not at all prepared for an early snowstorm. When they found themselves shivering and wading around in about a foot of snow, Ty walked over and asked Mr. Bandy if they should pull out. Mr. Bandy told them that they should not leave, because there was a chance of more good weather. According to Mr. Bandy, Ty did not even flinch. He just turned his head and said, "Boys, go get some overshoes, we are staying here." (57)

Mr. Bandy occasionally visited the survey parties while they were out in the field. He had been traveling around North Dakota, and found himself in the area near Columbus one long summer evening. It was after supper time, so he thought he would be able to find Jerry Campbell's party in camp. He was looking forward to it, since he had never met Jerry.

It was about 7 o'clock when Mr. Bandy arrived at Campbell's survey camp. He noticed one man out by himself removing a heap of large rocks from a fence corner. Mr. Bandy knew why he was doing it. The farmers cleared rocks from their fields, and piled them in the fence corners to get them out of the way. For a surveyor, though, it created a problem with which Mr. Bandy was familiar. He had worked in similar areas and knew what a job it was to wrestle those rocks out of the way in the hope of finding a marked stone corner. When Mr. Bandy learned that the man out moving rocks after supper was Jerry Campbell, he knew they had found a dedicated man. (57)

Mr. Bandy also qualifies as a dedicated man.

He completed a law course while he was a working cadastral surveyor. It must have been difficult, but he knew it would give him a better understanding of land laws, and he hoped that would make him a better surveyor. After 4 long years and plenty of dedication, Mr. W. R. Bandy was awarded a degree in law.

Before the Miesters, Kimmells, Crawfords and other families of surveyors had retired, another name began to appear on the roster of cadastral surveyors. It was not a family name, but it came up so often that people began to wonder about it. It was the name of a town, El Dorado Springs, Missouri. Roy Bandy has explained the repeated circumstance which made this small Missouri town so well known in cadastral surveying circles. It all started with Eddie Wilson, who worked on Mr. Bandy's survey party for awhile. Eventually, Ed Wilson went back to Missouri, bought a little store, and settled down. His wife was Inez Bandy's niece, so he and Roy Bandy kept in touch. Once, when Mr. Bandy needed some new recruits for his survey party, he let Ed Wilson know about it. Ed was acquainted with all the good, bright, hard-working farm kids around his area, and he had heard Mr. Bandy say more than once that bright, hard-working farm kids sometimes make the best surveyors. Ed talked to some of the boys, and one of them joined Mr. Bandy's party. The next time Ed Wilson talked to a boy who was really interested in surveying, he had him apply for work with the cadastral survey program in Montana. Mr. Bandy has said that Ed Wilson should be credited with bringing a number of good surveyors into BLM ranks, all from El Dorado Springs, Missouri. (57)

From the start of his cadastral survey career until his retirement in the middle 1950's, Mr. W. R. Bandy appeared to be a resourceful, farsighted surveyor. Several times he obtained results using innovative methods.

As early as 1924, the Forest Service requested that 100-foot contour intervals be shown on township plats of surveys within the National Forests. R. Y. Lyman, Charley Seeley, Guy Richardson, Dan Mumbrue, Ernest Parker, Al

Harris and Roy Bandy surveyed the first four townships requiring plats showing this contour interval. These were Townships 11 North, Ranges 1 and 2 East, and Townships 11 and 12 North, Range 1 West, Montana Principal Meridian. Roy Bandy was the man who established the vertical control for the survey.

On this survey he used a trailer tape. It has been said that James Yule, of the Forest Service, was largely responsible for its development. The trailer tape Mr. Bandy used was 5 chains long, and, used with a topographic clinometer, it showed true distances to all points along a line at all times, even on steep slopes. Mr. Bandy considered it a real improvement on mountain work.

Another innovation was used during the 1946 cadastral surveys for the Bureau of Reclamation. Arrangements had been made for the Bureau of Reclamation to use the section corners set by the General Land Office as horizontal control for their mapping program. This was done in order to eliminate the need for them to put in a horizontal control system of their own. The cadastral surveys were executed within the specifications necessary to meet the Bureau's requirements.

The Bureau of Reclamation had a contract with a mapping concern in San Francisco. Under the contract, large scale maps were to be prepared from aerial photographs. Roy Bandy was given the responsibility of pinpointing enough section corners or other control points, on the photographs supplied to them, to have a minimum of three control points for each section. Albert Penn and Mr. Perry were men trained in photo identification, and they were quite successful for a time. Then the wheat fields of Montana and the Dakotas brought them to a halt. In that sea of wheat, there were no fence corners, trees, or other ordinary landmarks to identify. Finally, the men noticed that ant hills, and the bare patches of ground around them, showed in the photographs. Mr. Perry, Mr. Bandy and Mr. Penn identified certain ant hills and made ties from them to the section corners. (57)

Even a man with Mr. Bandy's farsighted resource-

fulness would have been unlikely to foresee one dramatic effect of the cadastral surveys of the public lands. It was an effect certainly not anticipated by the men who were there at the beginning of the rectangular surveys, even though a similar effect was created by the land use pattern under the ancient Roman system of land subdivision.

During the middle 1960's, as part of the Gemini space program, Gemini V took photographs of earth from a distance of about 100 miles. At that distance, the works of man grow dim.

In the picture which showed the Imperial Valley of California and the northern part of Mexico, there was only one visible man-made feature. It was the pattern made by the United States cadastral survey system.

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